DAILY EDITION
Nineteenth Year

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Railway Age
AND RAILWAY REVIEW

Railway Engineering and Maintenance Railway Signaling

Chicago—FRIDAY, MARCH 9, 1928

Nineteen Years of Continuous Service
to the A.R.E.A. and the Railway Supply Industry

The heading at the top of this page says

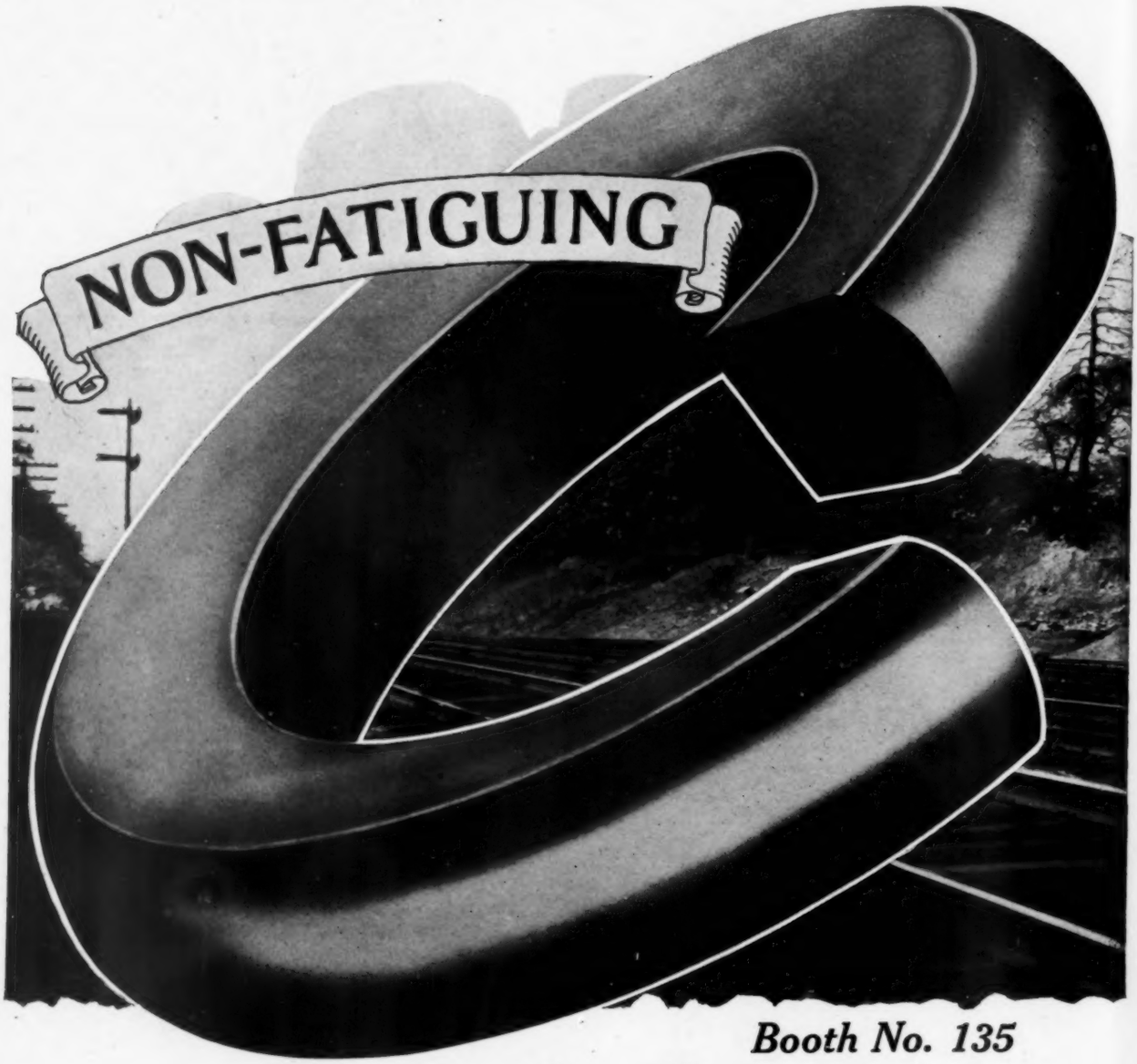
NINETEENTH YEAR

It's true. This is the nineteenth consecutive year in which THE DAILY has recorded the proceedings of the American Railway Engineering Association and described the exhibits of the National Railway Appliances Association. Most of the time the daily publication has been known as the RAILWAY AGE DAILY. Because most of its subject matter is of special interest to readers of RAILWAY ENGINEERING AND MAINTENANCE, the name of this publication was included in the title last year. For a similar reason, the name of RAILWAY SIGNALING has been added this year. THE DAILY, as it is now constituted, is of equal importance to the readers of all three publications and to the associations whose proceedings it records. THE DAILY is an established, continuous and growing institution.

It is continuous in another sense. In THE DAILY of 1910 was published a group picture of the workers on the publication of that year. Six of those same people have been busily engaged in preparing material for THE DAILY of *this* year; others who have been on THE DAILY nearly as long barely missed out on the picture.

The Simmons-Boardman Publishing Company is, therefore, using this space for its own purposes in thus calling attention to THE DAILY as now representing

NINETEEN YEARS of CONTINUOUS SERVICE



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Railway Age
Railway Engineering and Maintenance Railway Signaling
DAILY EDITION

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The Field Is Not Exhausted

SHOULD a rail splice act as a guide continuous with the two rails which it joins or should it serve merely as a hinge which holds the two rails together while allowing them to bend freely as independent beams? This is one of the perplexing questions raised in the course of the investigations of rail joints reported by the Committee on Stresses in Track. Men have talked learnedly on the behavior of track joints and on the manner in which this or that design is superior to others. They have given explicit reasons why a six-hole bar is better than a four-hole bar or vice-versa, but it is evident from the work of this committee in its tests of rail joints that present knowledge is incomplete and indefinite. This experience is nothing new. It has been repeated many times in the course of progress in engineering. Another outstanding example is found in the practice of proportioning concrete. Many books have been written which were accepted as presenting authoritative facts on the relation of strength to percentage of voids and work was carried out with full confidence in the tables of proportions which had been presented in these texts. However, subsequent investigations have proved that the earlier studies had largely ignored one important influence—namely the amount of water. Can any better proof be offered of the large field of usefulness for the A. R. E. A. in the future? There need be no fear that the work which the standing committees have done or are now doing has served to exhaust the subjects for further study. It is true that much which remains to be done will be in the nature of a review of the work of the past in the light of more complete information, but this will be of as much value as the exploration of new fields.

More Evidence of Sound Judgment

WHAT should be the disposition of track scales which have been removed by reason of inadequacy, obsolesence or inaccuracy? The Committee on Yards and Terminals has presented a sound answer to this question in the form of two conclusions contained in its report presented to the association Wednesday, and the good judgment of the association has been evidenced again in the adoption of these conclusions as recommended practice—(1) treat as scrap metal, after rendering unfit for further use as a track scale or parts thereof; and (2) retain for use as repair parts of existing scales of the same type and size. What other disposition could be made of obsolete track scales?—(1) retain for working over the parts into motor truck and other similar scales; (2) re-install in a new location; (3) sell as scrap metal in the same condition as removed from service; (4) sell as a scale in the same condition as removed from service; or (5) repair and sell as a complete scale. In spite of the fact that some roads continue to use these latter methods in disposing of their track scales, the committee dismissed consideration of them with few words, characterizing alternative 1 as impractical, alternative 2 as unjustifiable, and alternatives 3, 4 and 5 as entirely devoid of merit. The earnings of the railways, involving millions of dollars, are directly dependent upon the accuracy of their own track scales and those of the industries with which they maintain the industry track scale weighing agreement. The failure of either class of scales may result in grave losses to the railways or injustice to the industries concerned, a matter of so large importance that the railways should consider as inconsequential the resale value of obsolete or inadequate track scales. The committee stated very properly that if it is false economy for a railway to install a cheap or unreliable scale, it is also false economy for an industry to do so, and the more so in the latter case, because usually industries do not have and cannot afford the skilled forces and necessary facilities retained by the railways for the proper maintenance of their scales.

Special Rules for Concrete Design

A PERTINENT point was brought up during the discussion of the report of the Committee on Masonry yesterday morning. The question was raised as to the need for the association to adopt specifica-

tions or rules for the design of reinforced concrete structures to supplant or amplify the work of the Joint Committee on Concrete and Reinforced Concrete in which the association has participated. This brings up the broader question of national standardization and the extent to which the association is warranted in participating in the drafting of so-called national standards and in the adoption of such standards as its own. The case in point may be taken as an illustration of the limitations in the way of such co-operative work on the part of the A. R. E. A.

The representatives of the A. R. E. A. on the Joint Committee on Concrete and Reinforced Concrete have had an important part in the work of that body. Furthermore, the association's Committee on Masonry has given a great deal of time to the review of reports issued by the joint committee and there is no reason for anyone to question the spirit in which the association or its representatives have participated in this valuable work.

However, it is necessary to point out that the object of the joint committee is to formulate general principles that can be applied to all manner of concrete construction. Further than this is the fact that the personnel has been drawn primarily from among men whose work and interests are largely in reinforced concrete building construction. The result becomes clearly apparent after a careful reading of the joint committee's reports, namely that those who were responsible for the drafting of many of the clauses had pictured in their minds the needs and critical conditions arising in the design and construction of multiple panel and multiple floor reinforced concrete buildings. It may be said in justice to those who are responsible for this influence that, taken as a whole, structures of the character described are typical while railroad concrete trestles, cinder pits, coaling stations and roundhouses are distinctly of a special class.

But this explanation does not help the designer of railroad concrete structures or the officer who supervises the work of such designers and is called upon to settle the many fine points of design or loading assumptions which are raised by his men in the course of their work. It is to provide a guide for concrete work in the special field of railway structures that the Committee on Masonry has undertaken the work of providing rules for concrete design supplementing the joint committee's reports. We may be assured, however, that these rules will depart from the general principles enunciated by the joint committee only insofar as it is absolutely necessary to do so.

Stabilizing Maintenance Work

THE COMMITTEE on Economics of Railway Labor was quite emphatic in urging the adoption of an orderly prosecution of work throughout the year as a means of effecting economies in maintenance of way. "It has long been recognized in industry," said the committee, "that uniformity in volume of work and continuity in operations are essential to the maximum efficiency, and that as these decrease the cost of work increases." Probably there was formerly no work done in American industry which was more lacking in uniformity and continuity than railway maintenance of way work. It not only fluctuated greatly from year to year, as traffic and earnings rose and fell, but was subject to great fluctuations, even in months when seasonal conditions were favorable. The fluctuations in maintenance of way work have been reduced on many railways, but the committee notes that it is still true that "the general practice on many of our American railways of making maintenance allowances from month to month to conform to the wide fluctuations in earnings exerts a very heavy toll on the maintenance of way operations by added costs due to decreased efficiency in the force employed."

This is not a view expressed by amateurs in the study of railway practice who base their conclusion upon statistics without a knowledge of the practices from which the statistics result. It is a conclusion stated by practical maintenance of way officers, including representatives of 24 important railway systems extending into all parts of the United States. It shows that while progress toward stabilizing maintenance work has been made there is still room for much more progress in the same direction.

Practically all the unnecessary fluctuations in maintenance work are due to the policies of the managements and not to maintenance of way officers. They result from efforts of the managements to keep maintenance expenditures in line with earnings, the objective being to prevent seemingly undue fluctuations in net earnings. It is quite natural that railway managements should desire to stabilize net earnings and that, to this end, maintenance expenses should be increased when total earnings increase and reduced when total earnings decline. But the main objective of management should be, not to avoid fluctuations in net earnings, but to make them as large as practicable for an entire year and for periods of years. Whatever the causes, avoidable expenses result in the long run in reducing the net earnings of a year or of a period of years.

The conclusions reached by the maintenance experts of the railways regarding this and other matters should be given more weight in influencing management policies. To what extent are the higher executive and operating officers familiarized with the studies and conclusions of the maintenance experts? To what extent are they brought to the attention of those particular directors that are most potent in shaping the financial policies and thereby, to a considerable extent, the management policies of many railways? It is the proper function of maintenance officers not only to study and state their conclusions regarding problems within their special field, but also to make sure that their studies and conclusions are brought to the attention of the very busy men who must determine the broader policies of management. With respect to matters of this kind, the maintenance officers of an individual line may add great force to their own recommendations by showing their superior officers that they are not only their views but the consensus of opinion of maintenance experts who have studied the problems considered under the diverse conditions that exist on railways throughout the country.

We do not know to what extent the maintenance officers of individual lines take pains to bring to the attention of their higher officers the study given by the committees of the American Railway Engineering Association to maintenance of way problems and the conclusions reached, but we suspect they could do more of this than they do and that the effect upon operating and financing results would be very beneficial.

CONVENTIONALITIES

Correction

In the report of the banquet in Thursday's edition, page 560-D145, the committee presenting the banjo-clock to Mr. Faucette was erroneously referred to as the Committee on Records and Accounts. The credit for the idea and, incidentally, the clock, belongs rightfully to the Committee on Uniform General Contract Forms.

* * *

That prominent delegate with the worried look on his face is the one who received a telegram from his wife yesterday, reading: "Triplets arrived, more will follow by mail."

* * *

The members who attended the banquet Wednesday night, and it seems that they were all there, will remember that President Brumley read a telegram from Belleair, Fla., announcing that the A. R. E. A. program was coming in fine. It is interesting to note, in this connection, that the telegram in question was from Mrs. L. A. Downs, wife of the principal speaker of the evening, who thus had the opportunity of hearing her distinguished husband speak, although some 1,500 miles separated them.

* * *

We cannot let the convention pass into history without taking notice of the work of the Committee on Arrangements. They were indefatigable in their efforts to please the members and the approving comment from all sides indicates that they did their work well. The committee includes: Messrs. Knowles, chairman, Simpson, Scholes, Armstrong, Ambrose, Cox, Christian, Irwin, Hughes, Palmer, Fritch, Macomb and McDougall. Mr. Cox, by the way, has been a member of the committee since its inception.

* * *

One of those attending the convention, whose name is withheld for obvious reasons, was once appointed roadmaster of a division down south. He found the track in deplorable condition, particularly on a branch between two stations we shall call Beetown and Seaville, because those are not their names. Hardly had he arrived on the division when the vice-president came over the line and asked the roadmaster to ride to Seaville with him. As it happened, dinner was being served as the worst stretch of track was approached and the waiter brought on the meat course. "What's the matter, Sam, did you forget the soup?" he was asked. "No, suh, dey ain't no soup." "Why not?" "'Cause we'se ridin' between Beetown and Seaville, suh." Much surprised, the vice-president inquired: "What does that have to do with the soup?" "Well, suh, dis heah line jest ain't no soup railroad."

* * *

The straightening of the Chicago river between Polk and 18th streets, which necessitates a rearrangement of the tracks of the railroads passing through this territory was approved by the Illinois Commerce Commission on March 6, when a resolution was passed authorizing the city to proceed with the work. The project, which involves the removal of one-half a mile of the stream channel, 300 yards to the west, will cost $9,000,000, of which two-thirds will be borne by the railroads. Another project under consideration is the construction of a viaduct over the Union Pacific tracks at Central avenue, Cheyenne, Wyo., to cost $400,000 and another over its tracks at Grand avenue and Fremont street, Laramie. The municipalities will participate in the cost in each instance.

* * *

In their descriptions of conventions, newspaper reporters frequently use the line: "Delegates from every state of the Union." Except for the national political conventions and A. R. E. A. conventions, however, this line is generally far from the truth. However, last year, for example, persons attended the A. R. E. A. meeting from every state except Nevada and Oregon, while there were 40 Canadian representatives from five provinces.

Illinois, being favored by location, was first, naturally, with 216 present, with Missouri, Ohio, Pennsylvania and New York following in the order named. The following list shows all the states sending more than 15 representatives.

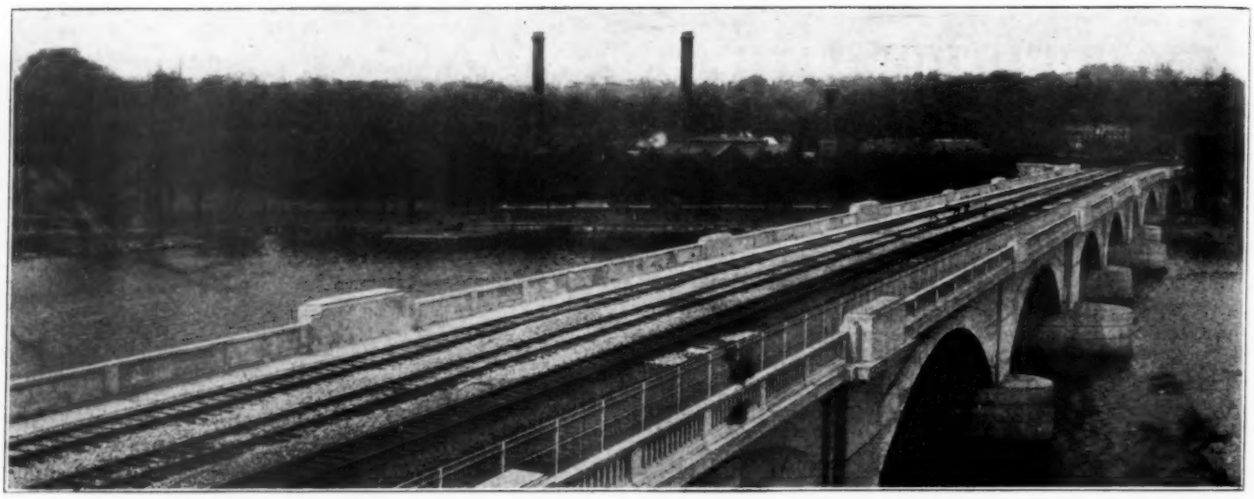
Illinois	216	Indiana	31
Missouri	104	Virginia	24
Ohio	83	Minnesota	24
Pennsylvania	60	Kentucky	22
New York	57	Maryland	19
Kansas	43	Arkansas	16
Michigan	37	Georgia	16
Texas	34	Iowa	15

* * *

New construction contracts pending include the following: the Chicago & North Western will close bids on March 9 for the construction of a concrete block and tile passenger station 22 ft. by 88 ft. at Carrollville, Wis.; the Denver & Rio Grande Western is accepting bids for the construction of five water treating plants in Utah, as follows: Cisco, 15,000 gal. of treated water per hour, Helper, 30,000, Farnham, 15,000, Wentworth, 15,000, Green River, 30,000; the Chicago Burlington & Quincy will close bids on March 12 for the construction of a 45,000 gal. per hour capacity water treating plant at Centralia, Ill. Bids will also be closed on March 8 by the C. B. & Q. for the construction of a 150-ton capacity coaling station at Stockholm, Wis.

* * *

Rear Elevation of Chief Engineer Morse of the Rock Island, Inspecting the Canadian River Bridge on the New Amarillo Line



An Excellent Example of the Railway Bridge Engineer's Work

The A. R. E. A. Concludes Most Successful Convention

The twenty-ninth annual meeting adjourned at 4:30 *p. m. yesterday after considering eight reports*

THE ANNUAL convention of the American Railway Engineering Association was brought to a close late Thursday afternoon by the installation of W. D. Faucette, chief engineer, Seaboard Air Line, as president. Yesterday's sessions were characterized by active discussion, particularly following the report of the committee on Grade Crossings.

Reports were presented during the day on Rail; Roadway; Masonry; Grade Crossings; Stresses in Railroad Track; Wood Preservation; Records and Accounts; Buildings and Co-operative Relations with Universities.

Report of the Committee on Buildings

FRANK R. JUDD (I.C.)
Chairman

G. A. BELDEN (C.of Ga.)
ELI CHRISTIANSEN (C.R.I.& P.)
A. C. COPLAND (C.& O.)
H. G. DALTON (C.B.& Q.)
F. M. DAVISON (N.Y.C.)
W. T. DORRANCE (N.Y.,N.H.& H.)
E. W. EVERETT (N.Y.C.)
HUGO FILIPPI (contractor)
E. A. HARRISON (A.T.& S.F.)
W. H. HOBBS (M.P.)

Frank R. Judd

J. W. ORROCK (C.P.R.)
Vice-Chairman

A. C. IRWIN (Port.Cem.Assn.)
E. A. JOHNSON (M.C.)
F. L. RILEY (B.& O.)
G. A. RODMAN (N.H.,N.H.& H.)
O. M. ROGNAN (N.P.)
A. L. SPARKS (M-K-T)
A. T. UPSON (Nt.Lum.Mfg's Assn.)
O. G. WILBUR (B.& O.)
A. H. WILLIAMSON (F.E.C.)

THE COMMITTEE presented reports covering the following subjects:

(1) Revision of Manual (Appendix A);

(2) Specifications for concrete used in railway buildings, collaborating with the Committee on Masonry (Appendix B);

(3) Artificial lighting for railway buildings (Appendix C);

(4) Methods for improving lighting, ventilation and the convenient arrangement of railway structures used in whole or in part for office purposes (Appendix D);

(5) Rules and regulations for employees of the build-

ing department, collaborating with the Committee on Rules and Organization (Appendix E);

(6) Design and construction of water station buildings, collaborating with the Committee on Water Service (Appendix F);

(7) Permissible grades for ramps in railway buildings, collaborating with the Committee on Yards and Terminals (Appendix G); and

(8) Specifications for buildings for railway purposes (Appendix H).

The committee recommended that the changes indicated in Appendix A be approved for substitution in the Manual; that Appendices C, F and G be received as information; and that the subjects of Appendices B and E be reassigned for further study.

Appendix A—Revision of the Manual

At the March, 1927, convention, amendments were made to Articles 12 and 16 of Section 12 of the Specifications for Railway Buildings, covering Structural Steel and Iron, by making provision for temperature stresses. The committee, after considering the matter, recommends that the amendments to these two articles be deleted and the text restored to its original version, as follows:

12. Members subject to stresses produced by a combination of dead load, live load and impact with lateral or longitudinal forces, may be proportioned for unit stresses 33 1/3 per cent greater than those specified in Article 6, but the section shall not be less than that required for dead load, live load and impact.

16. Provision shall be made for expansion in structures longitudinally. All expansion provisions shall be figured for 100° Fahr. variation in temperature and for a co-efficient of expansion of 0.0000065 per degree per unit of length.

Appendix B—Specifications for Concrete Used in Railway Buildings

This committee has prepared a specification for Concrete to be used in Railway Buildings, but the specification was not completed in time for submission for criticism to the Committee on Masonry. Therefore the specification was not submitted to the Association, and it was asked that the subject be reassigned.

Appendix C—Artificial Lighting for Railway Buildings

The subject of artificial illumination is of great importance. It has been estimated that 20 per cent of the total working hours in shops is spent under artificial lighting. The proper illumination of shops will insure much greater efficiency and reduce accidents from 20 per cent to 25 per cent. This means direct money saving to the railways. In freight houses, improper lighting causes a large proportion of mis-sent goods, and in storehouses it is the cause of much delay and expense through the selection of the wrong article from the racks.

There are two systems of lighting, namely, general lighting and local lighting. General lighting consists of the equal lighting of all parts of the area under consideration by means of permanent fixtures. Local lighting consists of desk lights and similar movable appliances to illuminate the object under observation.

Local lighting serves at times as an auxiliary to a general system.

The three great systems of general illumination are the direct, indirect and semi-indirect. The application of these three systems to meet the requirements of various types of buildings constitutes the chief problem of artificial lighting.

The light circuits should be installed with the service box located at some central point in such a way that all lights throughout the building can be controlled from this point.

The installation of lighting should in all cases be in accordance with local ordinances and also in accordance with the current rules of the National Board of Fire Underwriters. Close co-operation between the building and electrical departments is essential.

Shops

The lighting of shops is receiving more attention than ever before and is of great importance. Ample general lighting is more desirable than local lighting and there should be no shadows. Pits should be lighted and there should be plenty of floor and wall or post outlets for extension cords where interior work in cars is required. Inasmuch as all ceiling lights have to be above a traveling crane when the shop is so equipped, the crane should have lights on its bottom to prevent a moving shadow.

Yards and runways around shops and enginehouses should also be lighted and the most practical method is by means of flood lights of various sizes according to the area to be lighted. The use of poles for mounting should be avoided as much as possible and the lights mounted on buildings, craneways, etc.

Offices and Drafting Rooms

In offices where the position of the eye with respect to the light source must remain practically without change for considerable periods of time, fatigue rather than instant discomfort becomes the determining factor. This means that for best results the choice of units for offices is practically limited to totally indirect and dense glass semi-indirect luminaries. The highly diffused light from the totally indirect type is especially desirable in drafting rooms, where any shadow is very annoying. With indirect or semi-indirect lighting systems it is very essential that the ceiling and walls be light in color and of a dull finish and so maintained.

The lighting system in offices and drafting rooms should be designed to fit special classes of work and to permit flexibility in the arrangement of furniture and generously supplied with outlets for local lighting.

Passenger Stations

Waiting Rooms.—The principal requirements for lighting the waiting room is that of providing adequate illumination to create a cheerful yet comfortable atmosphere throughout and to permit reading with ease for short periods of time. No set rules can be made for the interiors of modern terminal waiting rooms. Each one requires individual treatment in order that the lighting may not only be in harmony with the architectural features but also comply with good engineering design. A competent illuminating engineer should therefore be called in to assist in planning these elaborate systems.

In modern terminal waiting rooms the lighting frequently consists of batteries of flood lights installed in balconies or concealed around the walls of the room, thus illuminating the ceiling and clere-story walls. The lower portion of the walls, the columns and cornices of the belt course are lighted by electric torcheres or floor standards, or fixtures attached to the seats.

In medium and smaller sized stations the enclosed type of luminaries is becoming more and more popular due to their utilitarian value and particularly low maintenance. In the small type stations it is desirable to provide means whereby this illumination may be reduced during the intervals when traffic is light.

The use of a few high wattage lamps is preferable to the older method of employing a cluster of low watt-

age lamps, since advantage is taken of the high efficiency of the larger lamps as well as their reduced overall operating costs.

Ticket Offices.—Enclosed or semi-indirect luminaries should be installed in the ticket office to provide general illumination. At the ticket window, operator's table, desk, etc., it is desirable to provide additional local lighting to facilitate speed and accuracy.

Toilet Rooms.—It is generally admitted that light is invaluable as a sanitary precaution, and therefore particular attention should be given to the arrangement of outlets to see that dark areas are eliminated.

Baggage Rooms.—Shallow bowl porcelain enameled steel reflectors with bowl frosted lamps should, in general, be employed.

Platforms and Exterior Lighting.—These lights should all be operated from a common point of control, and should be so placed as not to be objectionable to crews operating trains or to the handling of passengers. In the smaller stations, lights should be placed at exterior doors and along the cornices of long buildings, and on posts for lighting platforms throughout their entire length. Shallow dome reflectors and bowl frosted lamps are recommended. The covered sheds of terminals and umbrella sheds on platforms should have one unit per bay suspended from the roof and mounted high enough to clear loaded trucks.

Subways — Concourses. — For subways and concourses the most satisfactory arrangement of lighting units is to place them at intersection of walls and ceiling —one line staggered with the other. Supplementary lighting should be furnished at the stairs in order that no deceptive shadows be cast, and so arranged that the light will not shine in the eyes of pedestrians going up or downstairs.

Signs and Markers.—Electric guide signs to aid the traveler should be of such type that the lamps are not visible and the design in keeping with other architectural features of the building.

At the more important way stations the main station signs should be illuminated.

Freight Stations

Warerooms.—Warerooms should have sufficient illumination over the entire area to provide easy reading of labels and other markings in both horizontal and vertical planes. A straight overhead system of lighting is most satisfactory. Shallow bowl reflectors and frosted lamps are recommended and they should be placed close to the ceiling or at least 10 ft. above the floor to avoid loaded trucks and should be so located as to avoid shadows from beams, trusses, etc. Vaporproof equipment should be provided for cold storage rooms to prevent corrosion.

Loading Platforms. — Loading platform lighting should provide sufficient illumination for easy and quick movement of freight to and from cars. Outlets for extension cords to cars should be recessed along the edge of the platform or in the case of covered platforms along the edge of the canopy. When there are a number of parallel tracks, the extension cords should be fitted with combination socket and plug receptacles so that additional cords may be attached for each succeeding track.

Freight Offices.—Lights in offices should be as recommended for offices and drafting rooms.

Coal Chutes

To avoid personal injury to workmen and for the saving of coal, chutes should be well lighted throughout the interior of the structure. Exterior lights should be placed at the coaling aprons and at ladders and stairways.

Appendix D—Methods for Improving Lighting and Ventilation in Railway Structures

This work largely overlaps work which has been done or is being done by other sub-committees. The lighting of railway buildings is included in Appendix C. The ventilation of buildings including offices, was covered in 1925 and reported in Volume 26 of the proceedings. There is such divergence in the grouping of offices on account of the operating requirements of the various railways, and local conditions are such important factors that it is not thought advisable to make any recommendations upon this item.

Appendix F—Design and Construction of Water Station Buildings

The committee predicated its report on the report of the Water Service Committee, and offered the following information in amplification of the above report:

Steam Plants.—The size of buildings now in use for this purpose has been found to vary considerably, ranging in size from 16 ft. by 20 ft. to about 16 ft. by 28 ft., with sidewalls from 8 ft. to 14 ft. high.

Internal Combustion Engine Plants—Small Units.—The size of pumphouse required for this type of plant is related directly to the kind and capacity of equipment used and has been found to vary from about 12 ft. by 16 ft. to 14 ft. by 28 ft., with sidewalls from 8 ft. to 12 ft. high.

Electrically Operated Plants.—Buildings for this type can generally be made smaller in size than for internal combustion engine plants. A building 10 ft. by 10 ft. upward, seems to find common use.

Large Pumping Plants.—In general, such buildings should be of substantial construction and meet all special local requirements.

Pump Houses for Wells.—Buildings for this purpose are generally not over 10 ft. by 10 ft., but houses 10 ft. by 20 ft. and larger are used, depending on the capacity of the plant and the type of power used. A derrick frame, extending from 20 ft. to 35 ft. above the roof, should be provided. This frame may rest on the building or on a separate foundation.

Buildings for Water Treating Plants.—Buildings of this type are generally of frame construction. The size of building required is directly related to the method of treatment and the required capacity of the plant.

General Details of Construction

Foundation.—Owing to the proximity of water station buildings to a body of water, the ground is frequently unstable and particular attention should be paid to the design of the foundation so as to prevent unequal settlement. The foundation should preferably be of concrete, suitably reinforced and waterproofed if necessary.

The concrete work should extend at least 6 inches above the floor line, and sufficiently below frostline to insure good bearing soil.

Floor.—Floors should preferably be of concrete laid on suitable soil or fill, sloped for drainage, and reinforced where necessary.

Pits.—Pits and wells are built of brick or concrete, the latter being preferable. Where subject to hydrostatic pressure, these structures should be thoroughly reinforced and waterproofed, particularly when below high water level.

Interior Lining.—Lining of wood or other suitable material should be provided where climate or other local conditions warrant its use. In some cases an asbestos wainscoting five feet high has been provided to reduce the fire hazard. Ordinarily, water service buildings do not require a ceiling, the roof serving this purpose.

Steel Walls.—Corrugated galvanized iron siding may be used either on wood framing or, as in the case of fabricated steel buildings, on standard or special rolled sections. If used on steel studding, special provisions should be made for attaching furring strips on the inside for nailing the interior lining properly.

Ventilation.—Provision should be made in the roof construction for proper ventilation, especially where internal combustion engines are used.

Windows.—At least two check rail windows of suitable size should be provided in the boiler and pump rooms.

Doors.—One or more doors should be provided to permit entrance and convenient handling of machinery in and out of the building. For fire-resisting buildings, use should be made of steel, kalamein or tin-clad doors.

Appendix G—Grades for Ramps in Railway Buildings

Following a brief report on the pedestrian and trucking ramps in the Grand Central Station, New York, and the Chicago Union Station, and reference to the trucking ramps in the new general storehouse of the Chicago, Burlington & Quincy at Aurora, Ill., the committee offered the following summary:

(1) Ramps for pedestrian use surfaced with a non-slip material constructed with gradients as high as 11.6 per cent are being used in some large modern stations, but 10 per cent is recommended as a working maximum.

(2) Ramps for trucking service, either hand or power, develop difficult and uneconomical operation when the grade exceeds 7 per cent unless the distance traversed is very short.

(3) Results obtained from operation on ramps of these grades have been exceedingly satisfactory and it is felt that a great measure of the successful operation of the terminal facilities mentioned in handling people, baggage, mail and express, is due to the use of ramps and to the elimination of elevators, stairways, conveyors, etc.

Appendix H—Specifications for Railway Buildings

Under this assignment, the committee expressed its intention to supplement the specifications already adopted by furnishing paving and flooring specifications as follows:

Paving (Exterior)

No. 21-A—Brick
No. 22 —Concrete
No. 23-A—Wood Block
No. 24-A—Native Sheet Asphalt
No. 24-B—Petroleum Sheet Asphalt
No. 25-A—Asphalt Block
No. 26-A—Macadam
No. 26-B—Asphalt Macadam

Flooring (Interior)

No. 21-B—Brick
No. 23-B—Wood Block
No. 24-C—Native Asphalt Mastic
No. 24-D—Petroleum Asphalt Mastic
No. 25-B—Asphalt Block

This year's report included specifications for exterior paving of brick, concrete, wood block, asphalt block, macadam, and asphalt macadam, and for interior flooring of brick, wood block, and asphalt block. It was stated that the full series of specifications will be submitted later for publication in the Manual.

Discussion

[With Vice-President Yager occupying the chair, the report of the committee was presented by Chairman Frank R. Judd (I. C.). G. D. Brooke (C. & O.) moved *that the recommendations with regard to the revision of the Manual be adopted, and the motion was carried.* Appendix B was presented by Mr. Judd and received as a progress report. Appendix C on artificial lighting for railway buildings was then submitted by the chairman as information and as a final report.]

A. G. Dorland (E. J. & E.): The report says: "The proper illumination of shops will insure much greater efficiency and reduce accidents from 20 per cent to 25 per cent. This means direct money saving to the railways." I suggest that we eliminate the last sentence read, namely, "This means direct money saving to the railways." We should think of safety as a safety item and not put it on a dollars and cents basis.

W. H. Woodbury (D. & I. R.): I would suggest that the words after the word "accidents" be eliminated. It reduces accidents. That is all that is necessary, whether 20 per cent or 50 per cent.

Chairman Judd: The committee accepts that suggestion.

[A. L. Sparks (M.-K.-T.) then presented the subject of methods for improving lighting, ventilation and convenient arrangement of railway structures, used in whole or in part for office purposes.]

Mr. Sparks: There is such a divergency in the grouping of offices on account of the different operating requirements in the various railroads that it is not thought expedient for the committee to offer any suggestion for standard arrangement of offices. It is therefore recommended that this subject be discontinued.

[Hugo Filippi (William Grace Company) presented the report on the design and construction of water station buildings, which was accepted as information. Chairman Judd then presented Subject No. 7 which was accepted as information without discussion. Subject No. 8 was then presented by Chairman Judd with introductory remarks.]

J. C. Irwin (B. & A.): Attention should be called to the fact that in the specifications submitted, there are two paragraphs which properly belong in the contract forms and therefore should not be included in the specifications. I think it has been agreed that work of the Uniform General Contract Forms Committee should include such items as No. 1 General, and the last one, General Conditions. Therefore, I ask that those two sections be withdrawn from the specifications because they are covered in contract forms which will be used with the specifications.

Vice-President Yager: The committee is glad to receive that suggestion.

Hadley Baldwin (C. C. C. & St. L.): In reading over these specifications it struck me that there is a great deal of repetition. So many of the clauses in each different case are almost identical that for the purposes of recommended practice it seems to me the committee could combine these forms and take up much less space in the Manual and at the same time cover the ground.

Chairman Judd: These two clauses have been already accepted by the convention in about twenty other specifications and have been accepted for publication in the Manual, so to eliminate them from these particular specifications that are submitted this year will cause some complications and require the revision of the previously accepted specifications.

Mr. Irwin: This matter was brought up at two or three of the meetings with the chairman of the com-

mittee held after the convention each year, and I understood that the committee was instructed to omit certain specifications or items covered by the contract form.

Vice-President Yager: This matter is one which is subject to revision at any time and one for the development of uniformity in our Manual practice. It will be reviewed later by the appropriate committees with the proper collaboration as outlined in the assignments.

Chairman Judd: Relative to the question of repetition in these specifications, the committee has considered that phase of the matter from time to time and we have tried to boil each specification down to what is absolutely necessary to make a complete specification, but it is not thought advisable to constantly refer from one specification to another. We can do that, but to do it would in our judgment spoil the specification itself and make it practically an impossibility for the inspector on the job to keep up with the contractor, and for that reason we have aimed to make the specifications complete on each subject.

Mr. Irwin: I judge the specifications are not used independent of any contract form, and if you are trying to make a contract out of your specifications, there are a great many other sections that should be included.

[The committee was excused with the thanks of the association.]

Report of the Committee on Records and Accounts

J. H. HANDE (B.& O.)
Chairman

E. Y. ALLEN (Reading)
B. A. BERTENSHAW (C.C.C.& S.L.)
A. M. BLANCHARD (C.N.R.)
R. R. L. BULLARD (A.C.& Y.)
E. S. BUTLER (M-K-T)
E. B. CRANE (C.M.St.P.& P.)
J. W. DANSEY (A.T.& S.F.)
C. C. HAIRE (I.C.)
H. E. HALE (Pres.Con.Com.)
W. A. HILL (C.B.& Q.)

J. H. Hande

G. R. WALSH (M.P.)
Vice-Chairman

ALFRED HOLMEAD (Pres.Con.Com.)
C. A. KNOWLES (C.& O.)
HENRY LEHN (N.Y.C.)
H. T. LIVINGSTON (C.R.I.& P.)
E. W. METCALF (M-K-T)
C. K. SMITH (U.P.)
JAMES STEPHENSON (A.C.L.)
V. R. WALLING (C.& W.I.)
H. R. WESTCOTT (N.Y.,N.H.& H.)
LOUIS WOLF (M.P.)

THE REPORT made by the committee covered the following subjects:

(1) Revision of the Manual (Appendix A).

(2) Methods for reporting proportional increases in expenditures resulting from increased use of physical property and also through increase of property investment (Appendix B).

(3) Units or methods for use in control of maintenance expenditures from data taken from maintenance foremen's reports and used in preparing reports for the I. C. C. (Appendix C).

(4) The use made of aerial surveys and results obtained therefrom (Appendix D).

(5) Collaboration with other committees in the preparation and design of forms pertinent to their work (Appendix E).

(6) Revisions in I. C. C. Classification of Accounts (Appendix F).

(7) Plans, methods and forms for gathering and recording data for keeping up to date the physical and valuation records of the property of railways (Appendix G); and

(8) Methods and forms for handling the Interstate Commerce Commission's requirements under Order 15100—Depreciation Charges of Steam Railroad Companies (Appendix H).

The committee recommended that the conclusions in Appendices B, C and D be accepted as final and that the subjects be discontinued; that Appendices E and F be accepted as information; and that the report made in Appendix G be accepted for publication in the Manual. No report was presented on Appendix H, as the committee was instructed by the Board of Direction to discontinue study on this assignment pending the outcome of hearings on the order, scheduled for November 9, 1927.

Appendix A—Revision of Manual

The committee completed the rearrangement of material for the revised Manual in accordance with a comprehensive plan looking to a systematic building up of the committee's section of the Manual. An exposition of this plan is given in Appendix E.

Appendix B—Methods for Reporting Proportional Increases in Expenditures

The committee reported that it has reviewed the report of the Committee on Economics of Railway Operation, printed on pages 911 to 926, inclusive, of the 1925 Proceedings and adopted by the Association in March, 1925, for inclusion in the Manual. In this report detailed instructions are given for compiling the data under the two methods proposed.

It also reported that it has collaborated with the Committee on Economics of Railway Operation and that that committee is in accord with its own views that no special and ruled forms need be designed and recommended at this time, and that plain, unruled paper work

sheets only are necessary in applying either method recommended. In view of this, the committee recommended that this subject be dropped.

Appendix C—Methods for Use in Control of Maintenance Expenditures From Data Taken From Maintenance Foremen's Reports

The committee was of the opinion that the scope of its assignment is limited to the design of forms required in connection with the reports of the committees on Economics of Railway Operation, and on Economics of Railway Labor.

After collaborating with these committees, it agreed with the opinion of the committees that their respective reports require no specially designed forms. It then recommended that it be relieved from further study of this subject.

Appendix D—Aerial Surveys and Results Obtained Therefrom

Accompanying a bibliography of the more important books and articles which have been published on this subject, the committee submitted the following general statements.

Aerial photography is useful in supplementing the present ground methods of surveying. It has proved of direct practical value for engineering projects such as power transmission surveys, railroad location surveys, reservoir surveys, harbor surveys, large area maps, city maps, traffic studies, flood control, timber surveys, legal evidence, United States Geological surveys, War Department maps, Dominion Land surveys, tax assessments and city planning.

Aerial photographs are in general of two kinds, depending upon whether the photograph is taken with the camera pointing obliquely or vertically downward. The application of aerial photography to map making has been developed extensively by the United States and Canadian Governments. Private capital has also contributed a great deal toward development of aerial mapping in a practical way and in the United States several commercial companies are exclusively aerial surveying concerns.

Two distinct types of maps have come into use for engineering purposes, each of which offers special advantages for certain purposes. The mosaic or photographic map is built up of contact prints to produce a continuous photostatic representation of the area being surveyed. When component photographs are rephotographed to bring them to uniform scale the map is very satisfactory for reconnaissance purposes if the area mapped is flat or only slightly rolling. A line map is produced by transferring to tracing cloth or paper the more important features portrayed in the aerial photograph. Four methods of doing this have been developed:

1. In the method used by the United States Geographic Survey the photographs are rectified and the details desired are taken off on sheets which are sent to the field to have the contours, boundary lines, etc., added by the topographer. The final map is then made from those sheets.

2. In the Tennessee river method the contours are sketched on the original photographs in the field. The desired details are then transferred to the final map by hand methods.

3. In the Canadian method oblique photographs are used and by a system of perspective grid lines the features are drawn off to scale on the map.

4. In the fourth method the successive photographs are taken so that each point on the ground appears in three pictures. The photographs are rectified and by use of the stereoscopic principle, the elevation of desired points is located and the contour lines drawn on the photographs. The map is then drawn from the corrected and contoured photograph.

In surveys combining photography and ground work, the aerial work is usually done by companies specializing in that field and the ground work by the companies purchasing the photographic service. Aerial photographic service is usually done under contract to deliver certain material for a specified sum. The price depends upon the material delivered, the amount of flying involved and on flying conditions.

Conclusions

The committee is of the opinion that owing to the commercial nature of aerial surveying and the contractual relations existing between the purchaser and the company specializing in aerial photography, no recommended practice should be submitted at this time.

Appendix E—Collaborate with Other Committees in the Preparation and Design of Forms Pertinent to Their Work

Having collaborated with the various committees concerned, the committee, rather than waiting until forms are presented to it for its consideration and that of other committees, decided to give active consideration to the scope and field of its activity, with a view to determining its points of contact with the work of other committees.

To determine how adequately the forms and records recommended by this committee are supplying the needs of the railway engineering organization units, the committee endeavored to list, as completely as possible, all of the positions (functions), or units in a typical railway engineering organization and to check off the forms now available for each such position or function. From this it was felt that one should be able to tell what forms or records are needed that have as yet not been supplied.

In endeavoring to set up a typical organization outline, the committee chose to consider the entire matter from the viewpoint of "functions" rather than that of relative positions, and therefore divided the entire field of railway engineering into three major functions or departments: (a) Design and construction; (b) Maintenance; and (c) Valuation.

In the list submitted, the committee set up in each of the three major departments, a list of positions, the names of which will indicate the scope of the activities of that position, including under each position only those forms already designed and recommended. In each case reference is given to form numbers and pages where these forms appear in the 1921 Manual, and to bulletins where their presentation may be noted.

This list indicates the manner in which the committee recommends that its material for the new Manual be arranged. It was so made with the idea of facilitating the finding of a desired form as well as to furnish a check list that would serve to call to attention forms not yet designed.

It was the conclusion of the committee that all of the forms used by the engineering departments of railways in their routine operations, which are approved by the Association should be included in Committee XI's sec-

tion of the Manual, suitably classified and arranged for ready reference.

Appendix F—Progress Upon Changes or Revisions in I. C. C. Classifications of Accounts

The report on this subject was an extended and thorough resumé of the work done by various agencies interested in the revision of the I. C. C. classification of accounts, investigated and prepared by Alfred Holmead. The information in the report, which takes up 85 pages in the bulletin, was made up from material which has appeared either in printed bulletins issued by the Railway Accounting Officers' Association (which association has been in conference and co-operation with representatives of the Interstate Commerce Commission concerning the proposed revisions), in general notices issued by the secretary of the Commission, in annual reports of the Commission, or in published articles. The statement was devoid of discussion or comment by the committee, being a resumé of the work which has been done and the revisions proposed by the agencies directly involved in the work of revising the several classifications.

Appendix G—Plans, Methods and Forms for Keeping Up-To-Date the Physical and Valuation Records of the Property of Railways

The committee's report for this year consisted of a review of the previous two progress reports, and, in addition, a report was submitted, for the first time, on certain features of the assignment not previously covered. It was stated that new problems are constantly developing in connection with this subject, due to systematizing present methods and contemplated changes in the science of accounting; also, consideration must be given to the proposed Classification of Accounts and Depreciation Order, Docket No. 15100, of the Interstate Commerce Commission. It has become manifest that the committee's assignment must be kept alive indefinitely, or until conditions are more stabilized in valuation and accounting requirements.

The detailed report made by the committee covered the following subjects, and in each case recommended forms were submitted.

1. Definition of terms.
2. Organization for collecting, compiling, recording and filing.
3. Forms for recording changes in physical property.
   - (a) Field survey note books
   - (b) Final construction record
   - (c) Engineer's diary
   - (d) Record of side tracks
   - (e) Structural record—Buildings
   - (f) Roadway machine record
   - (g) Shop machine record
   - (h) Equipment index—Record of equipment changes
   - (i) Structural record—Bridges
   - (j) Rail chart
   - (k) Record of ballast changes—Ballast chart
   - (l) Record of rail in main track and record of heat numbers
4. Forms for analysis of expenditures and comparison with actual changes in physical property.
   - (a) "Consolidation Sheet" for analysis of expenditures
   - (b) Cost of property retired
   - (c) Cost data analysis
5. Mandatory forms required by federal regulations.
   - (a) A. F. E. form (Authority for expenditure)
   - (b) Detailed estimate sheet
   - (c) Record of property changes
6. List of units of railway property.
7. Recommended practice to follow, in reporting the construction cost and physical characteristics of a new line or extension.

Under Subject 2, organization for collecting, compiling, recording and filing, the report submitted consisted of a review of the material presented at the 1926 convention, and included previously in the proceedings. Under Subject 3, forms for recording changes in physical property, the committee resubmitted a number of forms previously viewed by the Association, and in addition, presented several new forms for adoption.

In discussing subject No. 4 (a), the committee stated that the purpose of a consolidation sheet is to furnish a work sheet so as to post each month all the material items used, together with the corresponding expenditures, and to accumulate these items and then finally to compare the accumulation of units with a final inventory, or units measured from some other sources than the accounts.

In handling the accounting for construction projects it is found that irregularities occur in accounting practice with such frequency that such a comparison is necessary for reason of the erroneous detail involved, and any differences must be credited or debited to the source.

The committee has found, in actual practice, that numerous work sheets always must be used, and in order to systematize the method it recommended the form which it presented as Exhibit 6.

Under Subject 4 (b) the committee pointed out the necessity for a suitable form to develop the cost of property retired in any system of records and accounts involving property retirements. It also pointed out approved methods and practices in recording retirements, and recommended the use of its form presented as Exhibit No. 7.

Under the Subject 4 (c), cost data analysis, it stated that there are a number of methods by which railways can record and accumulate construction cost data, but none suggests itself as flexible as the card index form, by units. Accordingly, the committee presented as Exhibit 8 a card index form which it recommended be used.

Under Subject 5, most of the material in the report was for review purposes, having been submitted previously to the association.

In reporting on Subject 6, List of Units of Railway Property, the committee stated that it has given consideration to the units that are ordinarily used in reporting and recording railway construction work and the units used by the Bureau of Valuation when inventorying the property of the railways in connection with federal valuation. Consideration has also been given to the published List of Units as designated by the Bureau of Valuation, collaborating with the Presidents' Conference Committee and published by the latter organization on January 10, 1921. The list of units published by the Presidents' Conference Committee has been widely distributed and is generally used by the railroads in complying with the requirements of Valuation Order No. 3. This list of units is similar to the units as used by the various districts of the Bureau of Valuation in their inventory work.

In respect to this subject, the committee concluded that the list of units published by the Presidents' Conference Committee on January 10, 1921, has been used successfully and it is practical to allocate costs to these units and to record the units in the manner made

mandatory by Valuation Order No. 3 and in any construction records. It suggested, however, a number of slight changes in the units as listed, feeling that such were necessary in view of changes in conditions which have occurred subsequent to January 10, 1921.

The report of the committee on Subject 7 is summarized in the following statements, which accompanied the recommendations of the committee for handling the accounting and engineering records for large projects.

In reporting the construction costs for new lines or extensions, a report in complete detail comparable to the Interstate Commerce Commission's "Engineering Report" should be made of the cost of each phase of the construction work, and, in addition, all the physical construction features should be faithfully recorded in a uniform way and in a manner easily accessible for future accounting and valuation use.

The present thought to bear in mind in designing an engineering and accounting report for a large construction project is to build up a comprehensive record for future use, so that the complete history in detail of the project can be available for future use and can be filed efficiently.

An important feature to be borne in mind is the proper preservation of the record, as constant handling may make it useless within a few years; therefore exceptional care should be taken in the selection of the paper and the use of cloth blueprints for certain of the folded map records.

The committee has concluded, after investigating this subject, that insufficient attention was paid by the carriers to building up for posterity records of the foregoing character; it therefore recommended that at the start of all large construction projects, carriers study this question and design reports and records along the lines recommended by the committee.

Discussion

[The report was presented by Chairman J. H. Hande (B. & O.) and the different subjects were introduced by the chairmen of the various subcommittees. H. E. Hale (Pres. Conference Com.) presented the matter dealing with a study of the methods for reporting increases in expenditures resulting from increased use of physical property and also through increases of property investment in collaboration with the Committee on the Economics of Railway Operation. His motion that *this subject be discontinued was carried.* B. A. Bertenshaw (C. C. C. & St. L.) presented the report on the methods for use in the control of maintenance expenditures taken from maintenance foremen's reports and his recommendation that the subject be dropped was accepted. G. R. Walsh (M. P.) then introduced the report on aerial surveys, which was received as information. In the absence of C. K. Smith (U. P.), subcommittee chairman, the report on collaboration with other committees was presented by Chairman Hande as information. The report on the progress made in the revision of the Interstate Commerce Commission classification of accounts was presented as information with the recommendation that the assignment be continued.

The report on the methods and forms for gathering and recording data for keeping the records of the physical property of the railroads up-to-date was presented by C. C. Haire (I. C.), who offered the matter on organization for final adoption for publication in the Manual. After some discussion this suggestion was withdrawn and the report was offered as information, after which the committee was excused with the thanks of the association.]

Report of the Committee on Masonry

C. P. Richardson (C.R.I.& P.)
Chairman
J. T. Andrews (B.& O.)
M. W. Beach (N.P.)
J. A. Bohland (G.N.)
G. E. Boyd (Ry.Age)
T. L. Condron (Cons.Engr.)
W. T. Davis (C.&O.)
T. L. D. Hadwen
M. Hirschthal (D.L.& W.)
A. C. Irwin (Port.Cem.Assn.)
G. M. Johnson (Wabash)
A. R. Ketterson (C.P.R.)
J. A. Lahmer (M.P.)

C. P. Richardson

Job Tuthill (P.M.)
Vice-Chairman
A. N. Laird (G.T.W.)
J. F. Leonard (Penna.)
Blair Ripley (C.P.R.)
F. E. Schall (L.V.)
L. W. Skov (C.B.& Q.)
A. W. Smith (C.N.R.)
T. M. von Sprecken (Sou.)
G. E. Tebbetts (C.R.T.)
R. A. VanNess (A.T.& S.F.)
C. C. Westfall (I.C.)
P. H. Winchester (N.Y.C.)
J. J. Yates (C.R.R.of N.J.)

THE COMMITTEE presented reports on the following subjects: (2) Principles of design of concrete, plain and reinforced, for use in railroad structures (Appendix A); (3) Progress being made in methods of concrete manufacture (Appendix C); and (5) Specifications for foundation work, including excavation, cofferdams, piling, etc. (Appendix D).

It recommended that the section of "Flexure of Reinforced Concrete T-Beams," paragraphs 137 to 143, inclusive (Appendix A), be adopted for incorporation in the Manual as recommended practice; that the data on concrete encasement of steel members, concrete piles, reinforced concrete columns and arches (Appendix A), and the monograph on flat slabs (Appendix B), be received as information; that the Board of Direction take under advisement the formation of a Joint Committee of Affiliated Engineering Societies to make a study and

report on "The Concrete Encasement of Steel Members;" and that the reports upon the progress being made in methods of concrete manufacture (Appendix C), typical specifications for foundations (Appendix D), and the waterproofing of railway bridges (Appendix E), be received as information.

Appendix A—Principles of Design of Concrete

In this appendix, the subjects were discussed under the five following heads: (1) Flexure of reinforced concrete T-beams; (2) Concrete encasement of steel members; (3) Pre-molded concrete piles; (4) Reinforced concrete columns; and (5) Arches. In handling the first subject, flexure formulas were developed, followed by a series of recommendations relative to the design and actual construction of concrete T-beams.

Under subject 2, the committee reported that concrete encasement of steel members has been common practice for many years, but never in design has it been permitted to consider the concrete as aiding the steel except for columns with a concrete core where it is sometimes taken into consideration. In fact, it is considered necessary to increase the amount of steel required in order to carry the weight of the concrete encasement.

A considerable number of tests have been made during the last five years to determine the relative strength value of the concrete, and while it is felt that these tests are neither sufficient in number nor sufficiently varied in character to justify definite recommendations, they indicate the following:

(1) That steel and concrete act together to form a composite member.
(2) That concrete encasement can be applied to a steel member so as to give a greater strength than that of the unencased steel.

Under the subject of pre-molded concrete piles, the committee made the following classifications: piles for foundations, and piles for trestle work. It reported that either pre-molded piles or piles molded in place could be used for foundation work, but felt that on account of varied requirements for each type of foundation, a standard design was not feasible. It reported further that it was not prepared to recommend a design for a pre-molded concrete pile for trestle purposes, but it submitted a typical design of such a pile, which is designed and constructed as standard practice on one Class A road.

In handling subject 4, the committee included some of the conclusions reached by Prof. Withey, of the University of Wisconsin, in his study of concrete column tests. It also included certain tentative remarks on reinforced concrete columns, which are given in part as follows:

The following sections on reinforced concrete columns are based on the assumption of a short column. Where the unsupported length is greater than 40 times the least radius of gyration (40R), the column shall be designed as a long column with suitable reduction in the allowable load. Principal columns in buildings shall have a minimum diameter or thickness of 12 in. Posts that are not continuous from story to story shall have a minimum diameter or thickness of 6 in.

The safe axial load on columns reinforced with longitudinal bars and closely spaced spirals enclosing a circular core shall be not greater than that determined by the formula:

$P = A_c f_c + n f_c' p A$

Where P = total safe axial load on column whose h/R is less than 40;
A = area of the concrete core enclosed within the spiral; the diameter of the core (or of the spiral) shall be taken as the distance center to center of the spiral wire;
p = ratio of effective area of longitudinal reinforcement to area of the concrete core;
$A_c = A\,(1-p)$ = net area of concrete core; and
f_c = permissible compressive stress in concrete = $300 + (0.10 + 4p) f'_c$

The longitudinal reinforcement shall consist of at least six bars of minimum diameter of ½ in., and its effective cross-sectional area shall not be less than one per cent, nor more than six per cent, of that of the core.

The spiral reinforcement shall be not less than one-fourth the volume of the longitudinal reinforcement nor less than one-half of one per cent of the core area. It shall consist of evenly spaced continuous spirals held firmly in place and true to line by at least vertical spacer bars. The spacing of the spirals shall be not greater than one-sixth of the diameter of the core and in no case more than three inches. The spiral reinforcement shall meet the requirements of the Tentative Specifications for Cold-Drawn Steel Wire for Concrete Reinforcement.

Reinforcement shall be protected everywhere by a covering of concrete cast monolithic with the core, which shall have a minimum thickness of 1½ in. in square columns and 2 in. in round or octagonal columns.

Lateral ties shall be not less than ¼ in. in diameter, spaced not more than 8 in. apart.

Reinforced concrete columns with spiral reinforcement, and subject to bending stresses shall be treated as follows: The compressive unit stress on the concrete within the core area under combined axial load and bending shall not exceed by more than 20 per cent the value given for the axial load by formula $f_c = 300 + (0.10 + 4p) f'_c$ (*Joint Committee formula* 43).

Under the subject of concrete arches, the committee stated that, whether plain or reinforced, they shall be designed on the basic of the elastic theory applied to arches of variable moment of inertia.

This assumes fixedness with unyielding supports resulting in:

(1) Span remaining constant (horizontally).
(2) Springing lines remaining at constant elevation (vertically).
(3) Tangent to neutral axis at supports being at constant inclination.

Stresses shall be figured for dead load, live load, temperature changes, and rib shortening. Maximum stresses shall be the algebraic sum of all of them.

Appendix B—Regulations for Flat Slabs

This appendix consists of a report covering regulations in flat slab design (four-way system), presented by M. Hirschthal, concrete engineer of the D. L. & W. It is abstracted as follows:

Moments for flat slabs designed for railroad locomotive loading shall be figured by the theorem of three moments for spans center to center of columns longitudinally for such locomotives as are held standard on the railroad in question.

The distribution of the live load moments shall be dependent on the distance center to center of tracks over which distance the live load may be considered distributed, where platforms need not intervene. That portion of the maximum positive moment included between the center lines of columns shall be considered as resisted by the two longitudinal half bands and the two diagonal bands in inverse proportion to the respective distances of the center of gravity of these bands to the center of live load moment on the panel.

The maximum negative live load moments along the center line of columns transversely as well as the posi-

tive moments at the centers of transverse bands shall be figured by the theorem of three moments, using the equivalent uniform load for the condition of maximum moment longitudinally, with the condition of one track loaded, two tracks loaded, etc., to determine the various maximum moments transversely.

The moments due to the uniform and concentrated dead loads (train shed or canopy columns, signal bridge supports, etc.) shall then be figured and distributed as indicated. The maximum live load moment plus the dead load moment plus the impact derived by use of the formula

$$\frac{L.L.M.}{D.L.M.+L.L.M.} \times L.L.M.,$$ shall be considered the moment to be resisted by the various bands.

For the reduction of the moment due to the shortening of the spans by means of the column design the various moments shall be modified by the coefficient $(1-C)^2$ where C is the ratio that the diameter of the column capital bears to the span length center to center of columns. The moment on diagonal bands shall then be modified by the relationship between diagonal and direct spans and by the fact that two diagonal bands transfer the stresses at the center of span.

In figuring moments in either direction the amount of end restraint or the lack of it shall be given consideration. In the case of the skew or irregular panels, each diagonal shall be considered as resisting the moment of diagonal bands in inverse proportion to the distances center to center of columns of the respective diagonals.

For slabs with drop panels the slab thickness may be assumed as obtained from formula $t_s=0.02L \sqrt{w+c}$ where L= span length in feet center to center of columns, w= total uniform load in pounds per sq. ft. and C= fireproofing protection to center of reinforcing steel; t_s is in inches. The depth of drop panel shall not exceed 1½ times t_s.

For slab without drop panels the thickness of the slab may be assumed from $t_s=0.026L \sqrt{w=c}$.

After the moments and shears have been found the slab thickness may be modified to meet these requirements.

In no case shall the slab thickness be less than $\frac{L}{32}$ for floor slab (nor $\frac{L}{40}$ for roof slabs).

The section to be figured for resisting the positive moment in any bands shall not exceed $\frac{L}{2}$ in width nor shall any steel other than that of the band be considered.

For negative moment the section to be considered shall not exceed the periphery of the drop panel, and only such reinforcement which extends 40 diameters beyond the column capital shall be considered as resisting the moment.

The compressive stress in the concrete resisting positive moment shall not exceed .35 f'_c and that resisting negative moment at the column capital shall not exceed .40 f'_c.

The allowable shearing and bond stresses in flat slab design shall be similar to those in simple slab, but the critical section for such stresses may be taken at a point distant from the column capital equal to the depth of the dropped panel and in the slab at a point at a distance from the dropped panel equal to the depth of slab.

The point of inflection may be assumed as being 0.25 L for slabs with dropped panels and 0.3 L for those without dropped panels. Reinforcement shall be so designed as to carry the bars either side of the point of inflection at least 20 diameters for all bands. At least one-third of the bars used for positive reinforcement shall extend into the dropped panel not less than 40 diameters and preferably beyond the center line of columns. Where there are no dropped panels the bars shall extend at least to within one-eighth of the span center to center of columns.

Appendix C—Methods of Concrete Manufacture

Appendix B of the Report of the Committee on Masonry, published in Bulletin 295, gives the fundamentals upon which the inundation method of sand measurement is based and outlines how to proceed in using the inundator. It was there pointed out that by measuring the sand in an inundated condition, a large part of the variation occasioned by the bulking of the sand when measured volumetrically is eliminated. In other words, the bulk of inundated sand is always the same, while, if the sand is measured by volume as in wheelbarrows, the actual amount of sand will vary considerably because of moisture content.

There are certain limitations, however, to the practical use of the inundator that may be noted. Basic proportions for concrete are usually expressed in terms of the dry, rodded aggregate, in order to eliminate errors due to the bulking effect of moisture and measurement of loose aggregate. Such proportions must be corrected to allow for the bulking of the aggregate.

The inundator does not correct automatically for changes in the grading of sand nor for the condition arising when the amount of water of inundation plus that in the coarse aggregate exceeds the specified total amount of water specified per sack of cement. Tests indicate that a volume of inundated sand contains somewhat less sand than the same volume of dry rodded sand, although it is usual to assume that sand in its inundated condition is equivalent in amount to dry rodded measurement.

The inundation method is limited to the measurement of fine aggregate and, in preparing to use the inundator, it is necessary first to work out the proper proportions, on the basis of dry rodded measurements, that will give the workability desired with the specified amount of water per sack of cement.

Whenever there is a marked change in the grading characteristics of the sand, it is necessary, if accurate control is desired, to redetermine the water of inundation and the ratio of inundation measurement to that of dry rodded.

When the amount of water in the coarse aggregate plus the water of inundation of the fine aggregate exceeds the amount of water that is specified, it is necessary to compensate for the excess water of the inundation.

Size of Concrete Mixers

So far as the committee was able to ascertain, no extensive tests have been made to determine the quality of concrete manufactured under similar conditions as affected by changing the size of mixers. Results of questionnaires sent to concrete machinery manufacturers indicate that in their investigations, the size of mixer has

little or no relation to the quality of the concrete produced.

Appendix D—Specifications for Foundations

The committee confined its work to a review and study of specifications for foundations obtained from a number of roads.

The committee selected certain abstracts from these specifications that are typical of the open well dredging caisson, the pneumatic caisson, and the floating caisson founded on pile foundations, which abstracts were published as information.

In its report, it cited specific instances in railroad structures where open well dredging caissons, pneumatic caissons, and floating caissons founded on pile foundations were used, giving a brief outline of each project and abstracts from the specifications that were in effect in each case.

Appendix E—General Practices for Waterproofing Railway Bridges

The questions asked by the committee and the replies received are given below, the letters used to indicate types of waterproofing being explained as follows:

Two layers of asphalt-treated cotton fabric and three moppings of asphalt.

Three layers of asphalt-treated cotton fabric and four moppings of asphalt.

Two layers of asphalt-treated felt, one middle layer of asphalt-treated cotton fabric, and four moppings of asphalt.

Two layers of pitch-treated felt, one middle layer of pitch-treated cotton fabric, and four moppings of coal-tar pitch.

Four layers of asphalt-treated felt, one middle layer of asphalt-treated cotton fabric, and six moppings of asphalt.

Four layers of pitch-treated felt, one middle layer of pitch-treated cotton fabric, and six moppings of coal-tar pitch.

Questions and Answers

Question 2—Does your company apply waterproofing in accordance with specifications presented by Committee XV and adopted by the 1927 convention?

22 roads substantially follow the specifications for waterproofing solid floors of railroad bridges recommended by Committee 15 and adopted by the 1927 convention; mileage 163,000.

11 roads do not substantially follow these specifications.

4 roads which replied did not indicate whether these specifications are followed.

Question 3—What type of waterproofing do you use? If you do not use either of these types, what is your specification?

19 roads use Type A.
8 roads use Type B.
5 roads use Type C.
2 roads use Type D.
5 roads use Type E.
4 roads use Type F.

Question 4—Does your company use asphalt or coal-tar products?

26 roads use asphalt between layers of membrane.
1 road uses coal tar products between layers of membrane.
9 roads use both between layers of membrane.

Question 5-A—What is your practice in the protection of membrane waterproofing? (On horizontal surfaces.)

7 roads use brick to protect membrane on horizontal surfaces.
18 roads use concrete to protect membrane on horizontal surfaces.
15 roads use asphalt mastic to protect membrane on horizontal surfaces.
7 roads use asphalt blocks to protect membrane on horizontal surfaces.

Question 5B—How do you protect membrane at bridge ends on vertical or sloping surfaces?

9 roads use brick to protect membrane on sloping or vertical surfaces.
18 roads use concrete to protect membrane on sloping or vertical surfaces.
5 roads use asphalt mastic to protect membrane on sloping or vertical surfaces.
1 road uses asphalt blocks to protect membrane on sloping or vertical surfaces.
2 roads use metal plates to protect membrane on sloping or vertical surfaces.
5 roads do not protect membrane on sloping or vertical surfaces.

Question 5-C—How do you allow for movement at expansion or construction joints to prevent rupture of membrane?

7 roads use copper plates or joints to prevent rupture at joints.
2 roads use galvanized sheet metal or lead plates to prevent rupture at joints.
11 roads fold membrane into joint or recess to prevent rupture at joints.
2 roads lay membrane over pipe which is later withdrawn to prevent rupture at joints.
3 roads use tar paper, felt or asphalt sheet to prevent rupture at joints.
5 roads have special design to prevent rupture at joints.
2 roads have no standard practice to prevent rupture at joints.
3 roads do not protect against rupture at joints.

In some of the groups in the above summary the number of railroads is greater than total number which furnished information because some of them follow more than one practice.

Discussion

[The committee's report was presented by Chairman C. P. Richardson (C. R. I. & P.), and at his request M. Hirschthal, (D. L. & W.), chairman of the subcommittee on design presented the matter in Appendix A. This was all offered as information with the exception of the formulas for flexure of reinforced concrete T-beams and his *motion for the adoption of that portion of the report for inclusion in the Manual was carried.* Following this J. L. Campbell inquired as to the reason for development work of this kind independent of the Joint Committee on Concrete and Reinforced Concrete.]

Mr. Hirschthal: This assocation has members on the joint committee. In 1926, the same subjects were discussed, and in the 1927 proceedings a monograph was presented by the speaker, and another on flat slabs, as well as one by Mr. T. L. Condron on columns. They were submitted to the joint committee for discussion and information. It appears that there has been no meeting of the joint committee since that time.

[Chairman Richardson then introduced the matter in Appendix C on manufacture of concrete and H. C. Crowell (Penna.) raised the question as to the furnishing of the cement by the railroad rather than its contractor.]

Mr. Richardson: The committee had a lengthy discussion of that point during the year and a large number of inquiries were made of the various railroads and contactors, but there was not sufficient preponderance of evidence to allow the committee to make any suggestion at this time.

Mr. Crowell: In our desire to get the fineness modulus, bulking factor and other varieties of refinement into these water-cement ratio specifications, of which I am generally in favor, I think we should not overlook the practical side of whether or not the cement in contract work should be furnished by the contractor or by the company. For example, if it is contractor's cement, you can rest assured there will be none too much of it used and there will be a tendency under the water-cement ratio specification to cut down on the water and have too dry concrete.

G. H. Tinker (N. Y. C. & St. L.): We are having

no trouble with concrete structures where the contractor furnishes the cement. The mixture and the control of the cement is entirely under the direction of the representative of the railroad company. So far we have had no complaint with any contractor.

Mr. Hirschthal: The danger of having the railroad company furnish cement, or any other single item in the construction work, is the division of responsibility. There is always a chance of the contractor coming back to the railroad and saying, "Well, that was your cement." On the other hand, the item of cement, as far as costs are concerned, is not such a large item. It would not pay the contractor to take a chance to "skin" on his cement and find that when the test cylinders come back his concrete shows a falling down of strength specified. On the Lackawanna we specify the strength with a cement-water ratio, and instructions are issued to the inspectors as to how to proceed in finding the mixture to be used for the particular aggregate then on the ground. We have found no trouble in handling the contractors that way.

[The matter in Appendix C was then received as information as were also Appendix D—Specifications for Foundations—and Appendix E, Practices in Waterproofing. The committee was then excused with the thanks of the association.]

Report on Stresses in Railroad Track

ARTHUR N. TALBOT (U.of Ill.)
Chairman
C. B. BRONSON (N.Y.C.)
JOHN BRUNNER (Ill.Steel)
W. J. BURTON (M.P.)
CHAS. S. CHURCHILL (Con.Engr.)
W. C. CUSHING (Penna.)
C. W. GENNET, JR. (Sperry R.Sv.)
H. E. HALE (Pres.Con.Com.)
J. B. JENKINS (B.&O.)
GEO. W. KITTREDGE (N.Y.C.ret.)

Arthur N. Talbot

W. M. DAWLEY (Erie)
Vice-Chairman
PAUL M. LABACH (C.R.I.&P.)
C. G. E. LARSSON (Am.Bridge)
G. J. RAY (D.L.&W.)
ALBERT REICHMANN (Am.Bdge.)
H. R. SAFFORD (G.C.L.)
EARL STIMSON (B.&O.)
F. E. TURNEAURE (U.of Wis.)
J. E. WILLOUGHBY (A.C.L.)

THE SPECIAL Committee on Stresses in Railroad Track again cooperated throughout the year with a similar committee of the American Society of Civil Engineers and presented the following progress report:

The subject to which the committee has been giving its principal attention during the past year is the rail joint, its function in the track, and the way in which elements of the design of the joint affect its behavior in the track. The work in the field has included both tests to find the stresses and movements of the joint and its parts and observations on the effect of time and traffic on the condition of the joint in the track. The work in the laboratory included tests of joints under controlled conditions of loading and reaction, thus giving information on some features of the action of the joint that can not well be learned in the track itself.

The problem involves the determination of the extent to which the rail splice in its various forms does and should act as a girder continuously with the rail, or possibly only as a hinged connection. It includes such features as the desirable length of splice bar, the effect of shape of bar and of fit against the rail, and the source of some of the forms of fracture found in joint bars. Information is needed on the amount of the tension existing in the track bolts, the range of desirable tension, and the change in amount of tension (increase or decrease) developed in the bolt as the wheel load passes along the rail. Pressures between rail and bar, wear, influence of spring washers, and other topics are also part of the investigation of the problem.

For the purpose of measuring the tension in the bolts of the rail joint, a strainmeter was devised which reached around the rail from one side to the other; a reading on the bolt as used or found in the joint and another when the nut had been loosened gave a measurement of the tension in the bolt, the device having been calibrated in a testing machine. This instrument, although its use was slow, gave useful information both in the laboratory and in the track. It can not be used to find the effect of the passage of a wheel load over a joint in the track. For such purposes new instruments have now been built. Special bolts of nickel steel, designed and built for the purpose and properly heat treated, are used in place of the ordinary track bolt. Drilled axially throughout the length of the bolt is a ¼-in. hole. A rod passes through this hole and is attached to the thread end of the bolt; at the other end it connects with a micrometer gage which is attached to the head of the bolt. Any change in length is indicated on the dial. The instrument is calibrated in a testing machine. For bolts with the nut on the outside of track a modification of this arrangement is used.

A large amount of data has been accumulated in the tests. The study of the results shows that the problem is very complicated, as would be expected from the presence of so many variables. Again and again the study of the data has been postponed until information on the source of certain phenomena observed or the meaning of certain results could be learned. Even with the ordinary form of joint the amount of the bending moment developed in it at the ends of the rail for a

given load varies greatly. The ratio of the bending moment developed in the joint bars to that developed in the full rail away from the joint, under the same conditions of loading, ranges from zero to approximately unity—from taking no bending moment whatever to carrying the full bending moment of the solid rail. This variation is an illustration of the puzzling questions that are being considered in the discussion of the data of the tests. Since the rail joint is an important and essential part of track construction, the more so as loads and rails grow heavier, it is to be hoped that the information obtained will throw light on the action of the rail joint and lead to the formulation of principles needed in the design of the joint and its effect on the upkeep of the track.

Discussion

[The report was presented by Chairman A. N. Talbot (U. of Ill.) who outlined the methods developed for obtaining the stresses in rail joints and track bolts and stated that the committee would be glad to have any suggestions concerning the problems on which it was working.]

Dr. Talbot: The work that has been carried on recently has been upon the rail joint. An effort is being made to determine the action of these joints in resisting or helping to resist the stresses which come upon the track structure as the load passes over it. This has been done with various types of joint and it is quite evident that the shape of the rail joint has a great deal to do with the way in which it behaves.

In connection with these tests, measurements have been made of the amount of the stress in the track bolt both as it is found in the track and as it would be used in our laboratory tests. It has also been determined whether there is any change, not exactly how much as yet, but whether there is any change in the tension in the bolt as the load passes over the joint. This information will help to determine what tension is desirable and whether that tension should be different with different forms of rail joints.

In this investigation of the joints in the track the effort is being made to find what the purpose of the joint is. We have always assumed that the joint is for the purpose of making a girder, the same as the rail makes a girder. That is the effort with most forms of joint.

Our measurements in the track have shown that the joint bar may take from zero amount of bending momement to as much bending momement as is found in the full rail at points away from the joint. That has complicated this matter very much, and we are still engaged in a study of the conditions which produce that. That isn't an easy thing because conditions of ballast have a good deal to do with it, and what would seem to be a joint that should go down at once may stand up under best conditions of track, ballast and form, for a considerable time.

[The committee was then excused with the thanks of the association.]

Report of the Committee on Roadway

C. W. Baldridge (A.T.& S.F.)
Chairman
Anton Anderson (C.I.& L.)
H. B. Barry (St.L-S.F.)
E. J. Bayer (P.& E.)
A. E. Botts (C.& O.)
W. G. Brown (F.E.C.)
Paul Chipman (P.M.)
H. A. Dixon (C.N.R.)
M. H. Doughty (D.L.& W.)
J. S. Goodman (Reading)
F. L. Guy (S.P.)
C. B. Harveson (B.& O.)
F. W. Hillman (C.& N.W.)
J. C. Holden (C.P.R.)

C. W. Baldridge

W. H. Woodbury (D.& I.R.)
Vice-Chairman
A. A. Johnson (D.L.& W.)
Noah Johnson (Wabash)
W. C. Morris (Sou.)
W. A. Murray (N.Y.C.)
E. C. Oyler (Penna.)
O. V. Parsons (N.& W.)
E. M. Smith (B.& M.)
W. C. Swartout (M.P.)
H. E. Tyrrell (Sou.)
Jamison Vawter (U. of Ill.)
W. D. Wiggins (Penna.)
J. R. Wilks (Ingot Iron Ry.Prod.)

THE COMMITTEE'S report covered the following subjects:

(1) Revision of the Manual (Appendix A).
(2) Corrugated Metal Culverts (Appendix B).
(3) Deformations of roadbed (Appendix C).
(4) Improved methods for preventing corrosion of fence wire (Appendix D).
(5) Specifications for steel fence posts (Appendix E).
(6) Permanent roadbed construction (Appendix F); and
(7) Methods for policing the right-of-way (Appendix G).

The committee recommended: that the specifications in Appendix E be adopted for inclusion in the Manual and that the subject be discontinued; that Appendices B, C and F be received as information and the subjects reassigned; that Appendix G be received as information and the subject discontinued; and that the report in Appendix D be accepted as a progress report, and the subject reassigned. No action was recommended under Appendix A.

Appendix B—Corrugated Metal Culverts

The committee reported that it has made little progress in the analysis of loads on corrugated culverts. The number of variable quantities that enter into the problem is so large that results from tests

other than the ones made at Farina will have to be included in the analysis in order that the committee will not be misled into erroneous conclusions. Information from tests that are now being made at various points will be necessary before much more progress can be made.

In undertaking its work, the committee divided culverts, according to their action under embankment loads into two types, right, and flexible. It then proceeded to develop the mathematical theory of the action of rigid culverts, following closely the theories of Dean Anson Marston, and then, in the light of experience and all other material available up to the present time, developed certain formulas relative to the action of earth pressures on flexible culverts, using empirical coefficients where such were necessary. As a result of its work the committee submitted the mathematical theory on culverts, brought up to date, and showed how the results obtained compared with the tests at Farina, Ill.

The committee reported that it is now considering deflection and moment formulas as applicable to corrugated culverts, and that its next step will be to study the side pressures in connection with the vertical pressures and supporting strength of the pipe itself at different deflections. It was stated that the committee will then be ready to specify the allowable deflection and recommended gages.

Appendix C—Deformation of the Roadbed

The points considered in the committee's work on the above subjects were: what depths of ballast give particular trouble, difference in maintenance cost for deeper ballast sections, maintenance costs in wet cuts or other places of poor foundation, and suggested remedies. Among the remedies considered were: drainage, deeper ballast, and concrete slabs.

Adequate drainage is the most important requirement for a railway roadbed and is very essential in the treatment of wet cuts and water pockets. Where the cost is not prohibitive the roadbed should be prepared by the removal of all inferior subgrade material and replaced with a better material applying at least 12 in. of high-class ballast. Where this cannot be done it is necessary to use some method of subgrade drainage to give relief.

Water pockets in cuts are in most cases natural, those in embankments are artificial. Water pockets in cuts may be remedied by providing outlet drainage below the bottom of the pockets and proper cross drainage. In embankments they will have to be tapped, either by driving pipe through the side of the embankment, laying drain tile, or by digging trenches from the side and back-filling with rock. Driving piling sometimes proves successful. In cuts they should be driven deep enough to permit the water to escape through the impervious strata that hold it.

In sudying the effect of deeper ballast the following pressure was obtained from a report of the Special Committee on Stresses in Railroad Track, 6-in. by 8-in. by 8 ft. cross-ties spaced 21 in. with 12 in. of ballast. The loading used was an E-60 locomotive. Allowing 50 per cent impact the maximum pressure at the bottom of the ballast was 6300 lb. per sq. ft. The report of the special committee indicated that with a depth of ballast of 24 in., the weight of the locomotive is uniformly distributed over the foundation.

In the 1927 report of the Roadway committee there is shown a section of an 8-in. plain concrete slab used by the Long Island. This company installed about 73,000 sq. ft. of this slab in 1912 under slip switches, frogs and crossings on a 22-ft. embankment. There is a movement of about 1,200 trains daily through the yard. The company reports that in the 15 years since they were installed there has been no frog or switch renewal until last year when one slip switch was changed. The slabs have cost nothing since they were installed and track work has cost very little. They have since put these slabs in at other points, and particularly on soft ground where they have served the purpose for which they were intended, i. e., to prevent track settling.

If a concrete slab were placed under the 12-in. ballast section, properly designed to care for the distribution of pressure figured above, a six-in. mesh reinforced slab or an eight-in. plain concrete slab would be required. This would cost roughly $4.50 per ft. of track on new construction and considerably more on old track. Twelve inches of additional ballast could be placed at about $1.25 per ft. of track.

The use of concrete slabs under existing track as a remedy for roadbed deformation is somewhat questionable, partly due to the cost and also since the track will have to be withdrawn from operation during the period required for the curing of the concrete. On the basis of the above costs it appears that in general, roadbed deformations may best be eliminated by, first, preparing the roadbed to stand a reasonable load, and, second, applying such a depth of ballast as will so distribute the load applied that the pressure per square foot will not be greater than the capacity of the roadbed. In certain bad spots the use of the slabs might be a desirable remedy.

Appendix E—Specifications for Steel Fence Posts

The committee widened the scope of its subject sufficiently to include iron posts in the specifications.

It reported that from its investigation, it found the use of steel fence posts rather limited, but that the present tendency is toward their greater use. It also stated that many roads have installations under test, but that some of the installations have not been in for a sufficient length of time to form the basis of a reliable report.

After certain preliminary statements relative to the history, types, advantages, strength, and application of metal fence posts, the committee submitted the following specifications for such posts, which it felt will prove satisfactory, both as to strength and durability.

Specifications for Metal Fence Posts

Classes—Metal fence posts shall be divided into two classes:
(1) Posts which support the straight away body of the fence shall be designated as "line posts."
(2) Such other special posts as are needed at the end or corner of the fence and at gates, shall be designated as "end, corner, and gate posts."

Material—"Metal fence posts may be made of steel or wrought iron, or alloys of iron of any kind which will pass strength tests as described below."

Strength—"Material used for fence posts shall have a minimum tensile strength of 40,000 pounds per square inch, and with a finished post, clamped rigidly, a load of 300 pounds, applied at three feet from the face of the clamp, the deflection shall not exceed six inches and the permanent set shall not exceed two and one-half inches. The load for this test shall be applied to the face of the post against which the fence material bears."

Ductility—"A finished post resting upon supports five feet

apart, and with a load applied at the center, must withstand bending eight inches from a straight line, with no signs of failure."

Workmanship—"All posts shall be smoothly rolled or formed and shall be straight throughout the length. Each finished post shall be free from burrs or other deformation caused by fabrication. They shall also be free from slivers, depressions, seams, crop ends and evidence of being burnt. (The above does not refer to rough places caused by zinc coating when galvanized.) Variations in length shall not exceed ½" over or under the prescribed length. Variations in other dimensions shall not be more than 1/16" over or under the prescribed figures."

Coating—All galvanized posts shall be galvanized by the hot dip process and shall possess a uniform coating of prime Western spelter or better grade with not less than two ounces per square foot of surface as determined by the spot test or by the Preece test with four dips. Galvanized posts are to be desired. All posts not galvanized shall be painted or dipped in a protective coating of metallic paint.

Special Fabrication for Line Posts—Line posts shall be fabricated to the section agreed upon by the purchaser. If the posts are not so designed as to make anchorage for alinement unnecessary, an anchorage device shall be rigidly fabricated to bottom portion of posts.

All posts shall be provided with some convenient means of fastening wire to same for at least 12 positions in a height of five feet, above the surface of the ground. All posts shall permit the refastening of the wire at least five times without damage to the connecting appliance, if an integral part of the post.

All posts shall be capable of being driven in ordinary earth without injury to the post.

All posts shall have sufficient length so that when installed with the required height above ground, one-third of the total length shall be underground, providing that the post shall extend into the ground not less than 2½ ft.

Special Fabrication for End, Corner and Gate Posts—All special posts shall be fabricated the same as line posts, except as follows:

All posts shall have sufficient length to permit installing 3 ft. 0 in. into the ground.

All posts shall be equipped with some suitable form of bracing and anchorage which shall aid in keeping the post vertical.

Weight—The main stem of all form sections not including tubing shall weigh at least 1.30 lb. per linear foot. Posts made of tubing shall be fabricated of at least ten gage material and not less than 1¾ in. in diameter.

Inspection—Inspection and approval of the posts shall be made by the Engineer or other authorized representative of the purchaser.

Appendix F—Permanent Roadbed

Collaborating with the Committee on Track, the committee submitted a joint report, which is abstracted in the following.

The committee endeavored to develop information as to whether the types so far used will be able to justify their continued use by proving conclusively that they require less maintenance. The railways experimenting with a type of permanent roadbed were canvassed and it was found that no data was available or maintained which could be compared with a stretch of track in the same locality, of the ordinary type of construction.

The New York Central and the Pere Marquette are, however, starting to keep costs on their respective types of construction and the committee is of the opinion that by next year it will be in a position to give comparative costs for one year at least. Further attempts will also be made to secure information from the other roads which are now experimenting along the same lines.

The committee made an inspection of the installation on the Pere Marquette during August and the following is given as to conditions existing at that time:

Concrete: No signs of failure.

Line: Not very good owing to the difficulty of aligning the bolt holes for the rail clips. If this type of track proves economical, a form of adjustable fastening must be developed.

Surface: Fair. Probably a part of the roughness is due to the insulating pads.

Insulation: The insulation placed under the rails throughout their entire length has crushed and squeezed out, allowing the rail to bear directly on the concrete. Some signal failures have also been noticed during wet weather.

Expansion: With the air at a temperature of approximately 80 deg. no joints were noted in which the expansion had not been lost.

Creeping: A tendency was also noted towards creeping.

Following a more detailed report on the installation of the Pere Marquette, by Mr. Chipman, which is along the line of Mr. Chipman's article on the Pere Marquette's installation which appeared in the January 14 issue of the *Railway Age*, the committee recommended that the report be accepted as information, and that the subject be continued.

Appendix G—Methods for Policing Right-of-Way

The committee understands the term "policing" as used in this subject to mean the caring for the right-of-way in every respect. Correspondence with members of the Association and the Roadway committee indicates that it is an almost universal practice to have the section forces police the right-of-way and station grounds. The books of rules of practically all carriers contain more or less instructions on policing, under track inspection, general instructions, and duties of section foreman. Apparently, all are agreed that there is a good return for the expense involved in one form or another, such as the advertising value, the good appearance of the property, reclaiming all scrap and usable material, preventing of fires, etc.

Improving the appearance of the right-of-way involves numerous actions. The time to begin the cleaning up of the right-of-way is while the roadbed is being built. All grading operations should, so far as possible, be conducted in such manner that no places shall be left so uneven that they will interfere with the mowing of right-of-way by mowing machines, nor should depressions or holes be left in which water will stand. Maintenance of way, however, must take care of the thousands of miles of right-of-way of the railways, as it now exists.

The extent to which waylands are prepared so that mowing and cleaning can be done neatly and economically, varies from nothing to very extensive work. After the right-of-way has been burned over in the autumn and before the vegetation grows again in the spring, it should be gone over and all stumps, snags, stone, trees, etc., should be cleaned out and burned or disposed of. Rough places should be smoothed over. By digging around them, old poles can be cut down low enough to be leveled off. Old fence wire and other rubbish should be placed in washes, or ditches, which it is desirable to fill up. Borrow pits and low places where water stands should be drained or filled up, surplus material from cleaning or ditching, etc., should be used to fill holes

and low spots or it should be leveled off so that a mowing machine will work over it without trouble. In some cases a tractor with a road grader can be used to good advantage in smoothing off the right-of-way.

To prevent fires, some roads clean the outer edge of the right-of-way from two to five feet in width. If the adjoining fields are susceptible to the spread of fire the more general practice is to have fire guards made by plowing a few furrows parallel to the right-of-way and at such distance outside of it as will prevent fire starting outside of the guards, due to sparks from passing locomotives. The killing of troublesome weeds and grasses can be greatly aided by burning over the right-of-way after the mown material has had time to dry.

The cost of mowing varies from nothing to $100 or more per mile, depending on the standard of the railway and the roughness or unevenness of the right-of-way, and the kind of growth to be cut. On one railway in Missouri and Kansas, the actual cost of mowing right-of-way in 1927 averaged (with right-of-way 100 ft. wide) by hand mowing, $41 per mile, and where teams could be used, $15.40 per mile.

Where shrubs, trees and flowers are maintained, the maintenance work is, of course, more expensive.

The practice of every railway company should be some method whereby the section forces, as a matter of routine, are required to keep their sections in standard shape, or condition, including general appearance. To give a good appearance, the ballast section should be clean with the toe line of the ballast and the sod, or bank lines, straight, or parallel with the track. Grass and weeds should be kept down. Usable material should be kept piled in neat piles and scrap material should be promptly conveyed to the scrap bins, both to improve the appearance of the railway grounds and to prevent its being lost in the weeds or covered up by excavated material, or in the ballast, and thus lost. In cleaning up right-of-way, like all other work, it is good practice to finish the work up to standard as the work progresses and not to leave it in a partially finished condition, expecting to come back and finish it at some other time.

The use of weed killing chemicals, applied with hand apparatus, around buildings may be done effectively. Care should be taken in its application so that ragged or irregular grass lines will not result from its use.

Fences should be maintained in straight lines or on uniform curves as required by the property lines. Wing fences, rail rests, stone trim or edging around signals and handcar setoffs, etc., can be improved in appearance at small expense by whitewashing. Trash, refuse, ashes, brush, etc., should be piled in designated places.

Discussion

[Past-President E. F. Wendt (Cons. Engr.) took the chair and the report of the committee was presented by its chairman, C. W. Baldridge (A. T. & S. F.), who read the various subjects by title only. W. H. Woodbury (D. & I. R.) chairman of the sub-committee on corrugated metal culverts, in presenting that report, reviewed the activities of the committee in its studies and the principles by which this work was governed. The report was received as information, after which the report on deformation of the roadbed was presented by Prof. Jamison Vawter (U. of Ill.) and was received without discussion. W. C. Swartout (M. P.) presented the fourth subject of the committee, on methods for preventing corrosion of wire fence, and outlined the tests being conducted by the committee.]

Hunter McDonald (N. C. & St. L.): In the early days in the use of fence wire the first kind we purchased was a flat wire with a barb fastened on by a straight turn over the plain edges with the points out. We applied a good deal of that wire to our fence about 44 years ago. We still have a good many fragments of that fence in use, and samples of it when examined show very little corrosion. All sources to whom I have referred samples of this wire have arrived at the conclusion that the long life of the metal was due to the honest galvanizing.

[A. E. Botts (C. & O.) presented the report of the subcommittee on metal fence posts and *moved that the specification be accepted for inclusion in the Manual.*]

J. L. Campbell (S. P.): I believe the association has a specification for galvanizing. If that is true, I wish to ask the committee if there is a provision for this particular specification for galvanizing.

Chairman Baldridge: I did not know that there were such specifications. [Mr. Baldridge then read the specification already in the Manual covering galvanizing, appearing under the general head of electricity and the sub-heading of specifications for galvanizing or sheradizing iron and steel and announced that the committee would agree to substitute for the matter under the head of "Coating", "All galvanizing shall be done as per specimens on galvanizing now in the Manual."]

Hunter McDonald: My understanding of the present methods of manufacture of woven fence wire and also of barbed wire are that the twisting and fastening and weaving is done after the wire has been galvanized, and that the galvanizing after dipping is wiped. I believe the railroads can get a more durable wire if they are willing to pay for it, and will have it galvanized without any wiping after it has been manufactured.

[*The motion to adopt the specifications as modified by the committee was passed.* The report on Permanent Roadbed Construction was then submitted for information by E. J. Bayer (P. & E.). In discussing the report of the committee, Paul Chipman (P. M.) outlined the results being observed on the Pere Marquette's test section of concrete roadbed.]

Mr. McDonald: I read the report of the engineer who had charge of the test on the Pere Marquette, and I was particularly interested in the difficulty he found in measuring the batter at some points and his calling attention to the fact that the batter at certain points was due to the one rail being somewhat higher than the other, which is a matter entirely due to the tolerance in the rails. He suggests the grinding down of the rails so as to equalize the two surfaces. I think that matter is one which will have to receive careful attention, but the matter of tolerance is something we can't get away from. These tolerances may occur in opposite directions at the same joint, and furthermore, the matter is complicated by the tolerances existing between the joint bar and the fishing surfaces of the rail to which the joint bars are attached.

A. N. Talbot (U. of Ill.): The question was asked whether there was a field for research in this line of the permanent roadway. I take it that Mr. Chipman will make systematic observation on the conditions of the track along the lines that have been referred to by him and that there will have to be developments in track fastenings, bedding of the rail and other things.

There seems to be some opportunity here to learn

whether the rail stresses differ in some marked way from that in rail supported in the usual way and if they do it may follow that a different shape of rail would better fit the conditions.

In the report of a year ago stress was laid on the value obtained in reducing the train resistance on track laid in this way. I had hoped there could be some report made on what differences there might be in the train resistance on the two kinds of track. I realize the difficulty with this in the short section. The ordinary dynamometer car would not be applicable perhaps, and yet I can see the possibility of using two or three heavily loaded cars and pulling it with some kind of a dynamometer at slow speed that might determine what differences there may be.

[In the absence of subcommittee chairman, Anton Anderson (C. I. & L.), F. W. Hillman (C. & N. W.) presented the report on the proper methods for policing the right-of-way, and the report was received as information without discussion. Following this report the committee was dismissed with the thanks of the association.]

Report of the Committee on Wood Preservation

F. C. SHEPHERD (B.& M.)
Chairman
W. G. ATWOOD (Cons.Engr.)
R. S. BELCHER (A.T.& S.F.)
Z. M. BRIGGS (Penna.)
C. S. BURT (I.C.)
G. M. DAVIDSON (C.& N.W.)
G. F. EBERLY (B.& O.)
J. E. FANNING (I.C.)
E. B. FULKS (Amer.Creo.Co.)
ANDREW GIBSON (N.P.)
W. R. GOODWIN (M.St.P.& S.S.M.)
R. S. HUBLEY (G.N.)
W. H. KIRKBRIDE (S.P.)
G. P. MACLAREN (C.N.)

F. C. Shepherd

C. F. FORD (C.R.I.& P.)
Vice-Chairman
F. D. MATTOS (S.P.)
W. D. PENDER (C.P.R.)
L. J. REISER (C R.I.& P.)
W. R. RHODES (M.P.)
DR. H. VON SCHRENK (Cons. E.)
W. L. SMITH (T.R.R.A.of St.L.)
O. C. STEINMAYER (Can.Creo.Co.)
G. C. STEPHENSON (Reading)
T. H. STRATE (C.M.St.P.& P.)
C. M. TAYLOR (Curtin-Howe)
J. H. WATERMAN (C.B.& Q.)
GALEN WOOD (Cons.Engr.)

THE REPORTS presented by the committee covered the following subjects: (1) Revision of Manual (Appendix A); (2) Definitions of terms used in wood preservation (Appendix B); (3) Service test records for Treated Ties (Appendix C); (4) Piling used for marine construction (Appendix D); and (5) The effect of preservative treatment with (a) creosote and petroleum (Appendix E); (b) zinc chloride and petroleum (Appendix F); and (c) air-seasoned Douglas fir (Appendix G). It recommended that the report given in each appendix, be received as information.

Appendix B—Definitions of Wood Preservation Terms

The committee submitted definitions of the more important terms now appearing in the Manual, with relation to wood preservation. A number of these are given below:

Absorption, Gross.—Total amount of preservative injected into wood during the treating operation.

Absorption, Initial.—The amount of preservative absorbed by the wood while the retort is being filled.

Absorption, Net.—The amount of preservative left in the wood after completion of the treating operation.

Coal Tar.—The non-aqueous portion of the liquid distillate obtained during the carbonization of bituminous coal.

Coal-Gas Tar—Gas-House Tar.—Coal tar produced during the manufacture of illuminating gas in gas retorts.

Coke-Oven Tar.—Coal tar produced during the manufacture of coke in by-product coke ovens.

Coke Test.—A test used to determine the amount of "fixed carbon" in creosote or tar.

Creosote.—A distillate from coal tar. It is heavier than water; usually contains separated crystals when cold but becomes liquid when heated; its distilling range lies about 200 deg. C. and the major portion distills below 360 deg. C.

Creosote Coal-Tar Solution.—Solution of coal tar in creosote in various proportions. Usually contains 20 to 40 per cent coal tar.

Distillation.—The process of separating creosote or tar into "fractions" having different boiling temperatures. The material to be distilled is placed in distilling flask, the temperature gradually raised and the vapors given off at various temperatures are condensed and collected separately.

Empty Cell Treatment.—A treatment in which the cell walls in the treated portion of the wood remain coated with preservative, the cells being empty or only partially filled.

Emulsion.—A mixture of liquids insoluble in one another. In wood preserving, a mixture of cresote or other oils and water or solution of a salt in water.

Expansion Factor.—Coefficient of expansion. A constant representing the change in volume of creosote for one degree of temperature.

Float Test.—A test used to measure viscosity. Used in testing creosote as a means of judging the amount of tar in solution.

Full Cell Treatment.—A treatment in which the cells in the treated portion of the wood remain either partially or completely filled with preservative.

Incising.—Puncturing the lateral surface of resistant wood as an aid in securing penetration by the preservative.

Increment Borer.—An auger with a hollow shaft used in removing a small core from wood for examination. Convenient for determining the depth of penetration in treated timber.

Recording Gages.—Automatic instruments for measuring and recording graphically the time, temperature, pressure and vacuum used in a treating operation.

Refractory Timber.—Timber which offers unusual resistance to the entrance of preservative; timber which is difficult to treat.

Refusal Treatment.—Treatment of timber by pressure until absorption of preservative practically ceases.

Refusal Point.—The point on the gage beyond which no more preservative can be forced into timber.

Sample Thief.—Apparatus for taking samples of preservatives from tanks or other containers.

Sap Drum.—Small tank or drum, located below treating cylinder for collecting sap or condensation during steaming.

Seasoning Oil.—Seasoning wood artificially by immersion in oil heated above the boiler point of water at atmospheric pressure or under vacuum.

Steaming.—Preparing green timber for treatment by subjecting it to the action of steam in a closed cylinder.

Tank, Charging.—A calibrated tank used for supplying preservative to the cylinder and measuring the quantity of preservative used in the treating process.

Tank, Drain.—Usually a horizontal, cylindrical tank so located that the surplus preservative can be drained into it by gravity upon completion of the treatment.

Tank, Measuring.—A calibrated tank sometimes used, in addition to the charging tank, for measuring the amount of preservative forced into the wood.

Tank, Mixing.—Tank equipped with agitating apparatus for mixing preservatives or making solutions.

Toxic, Poisonous.—Capable of killing wood destroying organisms.

Ullage.—The amount which a tank or vessel lacks of being full.

Vacuum, Final.—Vacuum applied as the final operation in the treating process; used to aid in the removal of surplus preservative injected and in drying the timber.

Vacuum, Initial.—Vacuum sometimes applied as the first step in the treating operation for the purpose of removing air from the wood cells.

Water-Gas Tar.—Tar produced in the manufacture of carburetted water-gas by the decomposition of petroleum oil by heat in the presence of blue gas.

Zinc Chloride.—A salt formed by the action of hydrochloric acid on zinc. Used in solution in water for preserving timber.

Zone, Samples.—Samples from a tank taken at a certain depth and in such a manner that they represent aliquot portions of the contents of the vessel.

Appendix C—Service Test Records for Treated Ties

In the committee's report a table was presented of additional completed service tests of crossties reported by the Forest Products Laboratory. This table is a supplement to the complete table printed in 1926.

The committee also revised and extended the table of tie renewals per mile which now includes 26 railroads. In addition to tabulating the insertions and renewals as given in this table, the committee made a detailed study of tie insertion records of many of the railroads whose tie performance is recorded in this table. It was hoped that a definite relationship could be shown between the number of treated ties inserted from year to year, and the tie renewals per mile in subsequent years. After a very extended study and analysis, it was found impossible to do this for the following reasons:

The number of ties removed per mile in any one year will depend upon a considerable number of definite factors, the more important of which are as follows:

(1) The proportion of untreated and treated ties laid each year.
(2) The type of treatment of the ties inserted, including herein the kind and the quantity of preservative used, and the character of the treatment.
(3) The kind of timber used.
(4) The type of track construction; that is, ballast, use of tie plates, weight of rail, whether ties were bored and adzed, etc.
(5) The density of traffic.
(6) The percentage of proper maintenance.
(7) The degree of approach to the normal age limit of treated ties.

Appendix D—Marine Piling Investigation

The committee's report consisted of reports on the recent inspections of the long-time test pieces prepared by the Chemical Warfare Service, some of its own members, the Army and Navy and other co-operators.

As reported by the committee, the materials under test were classified under the three main heads: Supposedly immune timber and mechanical protection; Chemical Warfare Service tests; and tests made by the committee itself. No report was made on experiments with creosote, as a full report on the Forest Service experiments was included in the 1927 report of the committee and it was thought unnecessary to include it again this year.

The timbers included in the first group are all indigenous to foreign countries. Not all specimens on which reports were submitted last year were included for various reasons, but it is expected that in another year a more complete report can be submitted.

The test pieces with scupper nail protection placed at the Pearl Harbor Naval Station are practically destroyed. The pieces are heavily attacked by *teredo* and *limnoria* and have eroded the wood to such a depth that many of the nails have dropped out.

The report of the committee's experiments followed an inspection of test specimens prepared by impregnation with various creosotes as described in previous reports. After detailed reports in each case, which also included the usual report on test piles, the committee offered the following summary:

The tropical timbers containing silica continue to show high resistance to attack except at Key West where limnoria have made a heavy attack on manbarklak.

The results from the turpentine wood confirm previous reports. In practically all cases the thin sapwood is attacked but no serious damage is apparent.

The Chemical Warfare Service specimens are beginning to show some attack, especially the No. 3 pieces treated with two arsenical compounds in a fuel oil carrier. The No. 1. pieces continue to show resistance, not only to attack by borers but also to encrustation.

The San Francisco tests of the various creosotes are still inconclusive because practically all test pieces are not appreciably damaged.

The piles from the "Long Wharf" of the Southern Pacific at Oakland which were redriven in various harbors on the Pacific Coast have been little damaged after 37 years' service.

Appendix E—Treatment With Mixture of Creosote and Petroleum

The committee reported on this subject in 1924, 1925, and 1926, and the report this year was a continuation of the subject, covering the creosote-petroleum ties in the Cleveland test section of the Beaumont division of the Santa Fe, inspection of which was made by the committee in October, 1927. As a result of this inspection, the committee prepared 25 tables, which accompanied its report, showing comparison of the various of groups of these test ties as to kinds of wood, pounds of creosote per cubic foot of timber, pounds of mixture per cubic foot of timber, and kinds of mixture.

The rainfall on the Cleveland test section in 1926 was 45½ in. and the gross tonnage over the section was approximately 4,253,000 tons. The ties are in dirt ballast.

Comparison of kinds of wood indicates better results from hewn heart pine and hewn gum than from the other woods.

Comparison of results on the basis of pounds of mixture absorbed per cubic foot of timber indicates lowest average life to date for those ties which absorbed less than five pounds of mixture. As yet, no one of these groups shows greatly better results than another.

Comparison on the basis of pounds of creosote (in mixture) per cubic foot of timber shows lowest average life in track to date for those ties which received less than one pound of creosote per cubic foot. To

date, however, no one group is strikingly better than another in this comparison. The records show that there is considerable variation in per cent removed up to date of inspection, but this variation does not point definitely to advantage of more or less mixture or more or less creosote per cubic foot.

The comparison this year of the several mixtures in this test, indicates somewhat better results from the one part creosote and two parts petroleum mixtures than from the one to three and one to four mixture groups. This is in line with the committee's findings in 1923.

It should be stated in connection with all of these comparisons, that mechanical wear in its various forms is responsible to a very considerable extent for the failure of ties which have been removed, which has influenced comparative results.

Considering the 815 creosote-petroleum ties as a whole, 154, of 18.90 per cent, have been removed from track for all causes during the 14 and 15 years they have been in track, and their average life in track up to the inspection in October was 13.88 years. There are 19 ties, or 2.33 per cent of the number inserted, which show some decay but not sufficient to make renewal necessary. It is of interest to note the following renewals each year for the past five years:

Calendar Year	Ties	Per Cent
1923	48	5.89
1924	109	13.37
1925	112	13.74
1926	130	15.95
1927	154	18.90

Appendix G—Preservative Treatment of Air-Seasoned Douglas Fir

The committee reported that it does not seem to be advisable to attempt to write specifications for air-seasoned Douglas fir for this years' report because of the fact that there is a very small amount of information additional to that when "Specifications for the Preservative Treatment for Douglas Fir" were submitted to the Association for adoption and publication in the Manual at the last convention and feels that it should attempt to obtain a history of Douglas fir in structures, ties and tracks before preparing specifications.

In order to secure this information, it reported that a questionnaire has been issued to gather as much available information as possible in dealing with past experience, before proceeding to prepare specifications.

Discussion

[The report was presented by F. C. Shepherd (B. & M.), chairman.]

Mr. Shepherd: A progress report is given on the definition of terms used in wood preservation. The report on Service Test Records for Treated Ties, includes a table of the additional completed service tests reported by the Forest Products Laboratory, and a revision of the table of renewals per mile including 26 railroads.

[Mr. Shepherd outlined the remainder of the subjects covered in the report.]

The President: All the subcommittee reports are submitted as informaiton.

[The committee was excused with the thanks of the association.]

Report of the Committee on Rail

Earl Stimson (B.& O.)
Chairman
E. E. Adams (U.P.)
Lem Adams (U.P.)
J. E. Armstrong (C.P.R.)
W. J. Backes (B.& M.)
J. B. Baker (Penna.)
A. F. Blaess (I.C.)
F. L. C. Bond (C.N.R.)
C. B. Bronson (N.Y.C.)
E. E. Chapman (A.T.& S.F.)
W. C. Cushing (Penna.)
J. M. R. Fairbairn (C.P.R.)
J. M. Farrin (I.C.)
L. C. Fritch (C.R.I.& P.)
E. A. Hadley (M.P.)
C. R. Harding (S.P.)

Earl Stimson

Hunter McDonald (N.C.& St.L.)
Vice-Chairman
R. H. Howard (Wabash)
L. J. F. Hughes (C.R.I.& P.)
John D. Isaacs (S.P.)
C. W. Johns (C.& O.)
R. Montfort (L.& N.)
A. W. Newton (C.B.& Q.)
W. H. Penfield (C.M.St.P.& P.)
G. A. Phillips (L.V.)
G. J. Ray (D.L.& W.)
C. P. VanGundy (B.& O.)
F. M. Waring (Penna.)
W. P. Wiltsee (N.& W.)
Louis Yager (N.P.)
J. M. Young (Reading)

THE REPORT of the committee covered the following subjects:

Mill Practice

The committee continued its study of mill practice as affecting quality of steel rail and called attention to Appendix A, which outlined improvements that have been made at the various steel mills.

The committee has undertaken jointly with the rail manufacturers investigations which will be referred to later under transverse fissures.

Transverse Fissures

Last year's report referred to the development of a device for the detection of transverse fissures in rail steel. The committee now reported that following the highly satisfactory completion of laboratory tests of a simple stationary type of this device, a test car has been constructed designed to print, simultaneously, records of transverse fissures existing in both rails in track when the test car is hauled over the track at a speed of approximately 10 m.p.h. This device will segregate

such fissures as to size and automatically mark the defective rails by means of a paint spray applied to the outside of the webs of the rails.

Transverse fissure statistics have been extended to include all failures from such cause reported up to January 31, 1927, and are presented as Appendix C. The record now comprises a total of 27,346 transverse fissure rail failures. The 1926 rollings from all mills produced in the first year of service 72 per cent more fissure failures than did the 1925 rollings during their first year of service.

The committee presented as Appendix D, a progress report on the subject of rail batter, in collaboration with the Committee on Track. It also reported progress on the subjects of the economic value of different sizes of rail, reconditioning of battered or worn rail ends, and drilling and spacing of holes in rails of all weights.

No changes were recommended in the Manual, and the reports in Appendices A, B, C, and D, were recommended be received as information.

Rail Failures

The committee presented rail failure statistics for the period ending October 31, 1926, as Appendix B, which is given below.

Table 1—Average Failures Per 100 Track Miles

Year Rolled	Years' Service 1	2	3	4	5
1908	.....	.....	.....	.....	398.1
1909	.....	.....	.....	224.1	277.8
1910	.....	.....	124.0	152.7	198.5
1911	.....	77.0	104.4	133.3	176.3
1912	28.9	32.1	49.3	78.9	107.1
1913	12.5	25.8	44.8	69.5	91.9
1914	8.2	19.8	32.9	50.9	74.0
1915	8.9	19.0	34.2	53.0	82.4
1916	11.8	29.2	47.7	70.6	105.4
1917	21.6	38.9	66.0	110.5	137.0
1918	8.9	27.6	54.9	92.8	125.4
1919	14.8	39.4	73.7	104.8	115.7
1920	14.2	32.4	63.1	84.5	119.6
1921	10.9	34.9	56.9	70.9	98.9
1922	15.9	34.8	55.2	80.4	.....
1923	14.3	33.2	57.6	.....	.....
1924	14.0	33.4	.....	.....	.....
1925	15.5	.....	.....	.....	.....

The five-year record of the 1921 rollings is materially better than any rolling since 1925 as was forecast in last year's report. The four-year record of the 1922 rollings indicate that the improvement in the failure rate will continue, but probably will not quite equal the low rate of the 1921 rollings.

The committee again presented in the rail failure report a chart showing the rating of mills through the use of the traffic density factor, as well as the rating by its usual method.

Appendix A—Details of Mill Practice and Manufacture

Several important changes and improvements have occurred in rail manufacturing processes within the past year or more, which are in part directly traced to the changing requirements of the railways.

Rail production records show a marked increase in the demand for heavier rails, particularly within the last five years. The percentage of rails of 100-lb. per yard or heavier to the total rail production increased from 28 in 1920 to 61 per cent in 1926. Increased weight, combined with the almost universal adoption of the 39-ft. standard length, has affected rail handling methods in the finishing mill and back as far as the open-hearth department.

In the open-hearth departments, changes have been made in furnace construction. Tar and oil have been used on some furnaces to increase the intensity and sharpness of the flame action, and decrease the sulphur carried into the bath. The work at the pouring platform at some mills has been improved by coating the interior of the molds with both graphite and tar.

The permissible increase in percentage of silicon which was introduced into the A. R. E. A. and other rail specifications has reduced or eliminated the necessity of "killing" the steel in the molds with aluminum.

Stopper rods and nozzles for ladles have received considerable attention, and improvements have been made in the type and materials used to reduce the liability of spattering.

Some mills have introduced changes in the shape and size of ingot molds, and have thus reduced the possibility of weakness in the corners of the cast ingots.

"Hot top" molds were also used on sizable experimental tonnages by three different roads independently. The purpose of these tests was primarily to determine what effect this type of mold has on the various processes involved in rail manufacture.

Changes have been made in both the type and composition of the rolls used at some of the rail mills for the purpose of increasing their life and usefulness, reduce roll failures, and by reducing the wear on the roll obtain rail sections which are closer to template. The desirable practice of wash heating the blooms after the ingot has been reduced to bloom size and before rolling into rails has been extended.

A decided improvement has taken place in the hot sawing of rails at several rail mills. Automatic and adjustable curving or cambering rolls have been installed and are proving of great value in eliminating the drag and blurring of the burr from the hot saw cut.

The practice of spacing of rails on the hotbeds to promote uniform cooling is now being followed by several of the rail mills, and has resulted in a noticeably smoother rail at the straightening presses and a reduction in the amount of gagging required to straighten rails.

The classification of rails as to quality, fitness, etc., as outlined in the A. R. E. A. and other specifications, has necessitated remodeling the finishing mills at many rail plants. The change from the 33 to 39-ft. standard length required the expenditure of several million dollars in the aggregate for all of the rail mills.

There has been a considerable increase in the demand for intermediate or medium manganese, which is a steel of promising superiority over the standard open-hearth composition. Experimental lots of heat-treated rails have recently been installed on five different railroads on sharp curves in heavy traffic territory. Cumulative data are being secured on the relation of cost, physical characteristics and wear, compared to standard untreated rails.

Appendix B—Rail Failure Statistics for 1926

The report included in this appendix was presented by W. C. Barnes, engineer of tests, of the Rail Committee. Included in the report were the following tables and figures: Table 1—Average Failures per 100 track miles; Table 2—Summary of 14 years reports, showing track miles laid originally, total failures, and failures per 100 average track miles in service; Table 3—Failures for various ages of rail per 100 track miles; Table 4—Recapitulation, totals and averages grouped by mills; Table 5—Average weights of rails compiled from tonnages used in the report; Figure 1—Rail failures of the United States and Canada, 1913 through 1925; Figure 2—Records of failures per 100 track miles for five years' service, for rollings from 1908 to 1921; Figure 3—Average failures classified by mills; Figure 4—Average failures by mills as affected by use of traffic

density factor; and Figure 5—Accumulated failures for rollings from 1921 to 1925.

In commenting upon the various tables and figures, the report included the following statements:

The 1921 rollings, whose period of observation is now concluded, show a lower failure rate than any rolling since 1915, as was forecast in last year's report. The four-year record of the 1922 rollings indicates that the improvement in the failure rate will continue, but probably will not quite equal the low rate of the 1921 rollings.

From Table 4 and Figure 5 it was pointed out that Inland again shows the lowest failure rate, but this is somewhat offset by the fact that no 1921 rail is represented therein. Illinois again shows the lowest rate on a comparable basis with a figure of 8.32. Pennsylvania is next in line with 11.17, followed by Colorado with 12.31, and Carnegie with 12.67.

Appendix C—Transverse Fissure Statistics

The report in this appendix was prepared by W. C. Barnes, engineer of tests, of the Rail Committee. Comment upon the tables included in the report contained the following which is given in part:

These statistics constitute a cumulative record of 27,346 simple transverse fissure failures that have been reported up to and including January 31, 1927. The total reported up to January 31, 1926, inclusive, was 22,750 and that up to January 31, 1927, 27,346, or an addition during the year 1926 of 4,596 fissure failures.

Table No. 2 classified all the fissure failures accumulated from year rolled to January 31, 1927, for each year's rollings from each mill unweighted by tonnage output of mills and by amounts of traffic carried. This table is most useful in comparing the failures in the various rollings from any one mill.

The rollings of 1910 from all mills continue to show the maximum number of fissure failures (2,912), which is due to the exceptionally bad record of the 1910 rolling from Illinois. The 1913 rollings from all mills are a close second with 2,821 failures, influenced largely by Illinois and Maryland rollings. The greatest number (502) of failures for all mills in 1926 occurred in the 1917 rollings, for which the excessive failures of Illinois 1917 rail are responsible.

Table No. 3 gave for each mill the rate of total transverse fissure failures on 31 selected roads accumulated to January 31, 1927, per 10,000 tons of rail reported on, by years rolled. This comparison includes a total of 22,225 fissure failures.

Table No. 4 classified the accumulated transverse fissure failures by rail letter and by weight of section, by mills. For all mills the majority of the fissure failures occurred in the A rails and this holds in the case of individual mills such as Colorado, Illinois, Lackawanna, Pennsylvania and Tennessee, but other mills consistently show the failures to predominate in the B, C or D rails.

Appendix D—Cause and Prevention of Rail Battering

Collaborating with the Committee on Track, the report in this appendix was quite extensive. In response to an inquiry, the committee received a letter from W. C. Cushing, engineer of standards of the Pennsylvania, in which he pointed out the enhanced physical qualities of certain heat-treated steel rails which have been used on his road. These are as follows:

		Per Cent
(1)	Increase in elastic limit per sq. inch	52.4
(2)	Increase in ultimate strength per sq. inch	18.0
(3)	Increase in elongation by tensile tests	39.3
(4)	Increase in reduction of area of specimen tensile tests	141.1
(5)	Increase in angle of bend before rupture	343.5
(6)	Increase in number of drop test blows before breaking	10.0
(7)	Increase in Brinell hardness	23.5
(8)	Increase in resistance of impact (Izod)	50.0

After an inspection on the reading, relative to the battery of rails laid with "head-free" joints, the committee formulated the following opinions:

(A) That sufficient attention had not been in past years bestowed on the care of the rail during and after laying, such neglect generally taking the form of inadequate anchorage against creeping, improper expansion spaces, excessive bolt tensions, failure to check the bad effects of end overflow by sawing off and deferring too long the welding up of rail ends.

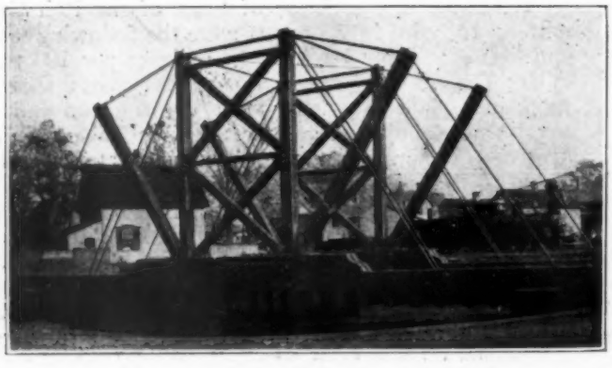
(B) That the end overflow takes place not only with open joints but also where joints have been laid and maintained without expansion space. That in either case chipping may be greatly reduced by systematic and judicious readjustment of joints which are found open at rail temperatures ranging about 120 deg.

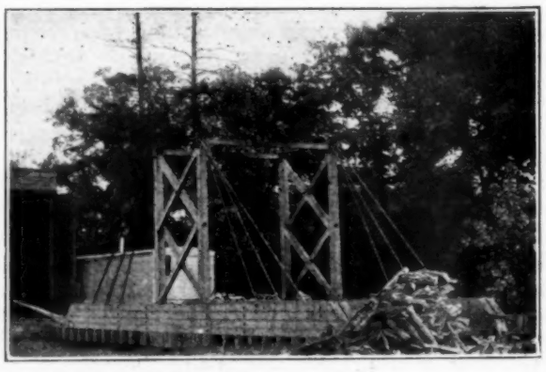
(C) That rail ends which show a batter of 3/64 in. should be built up by the welding process.

(D) That it is not economical to weld rail ends out of face and that welding should be limited to joints where the rail ends show on one side or the other of the joint a batter of 3/64 in. or more or excessive chipping.

(E) That where joints have been built up by the welding process, metal which has adhered to the ends of the rail in the joint gap and which will interfere with expansive movement of the rail should be removed.

(F) That rail battering on high-speed tracks with mixed traffic usually in one direction may extend on the receiving rail to a considerable distance beyond the joint gap. In such cases the cost of labor and material





Early Turntables Prove the Progress in Present Practice

required in welding up should be balanced against the cost of resawing and redrilling.

(G) It was the unanimous opinion that the general milling of rail ends in order to reduce chipping is not necessary.

The report included three exhibits of the results of tests made on rail, relative to battering, and it was stated that it is the intention of Hunter McDonald to continue observations on the relative rate of battering of high and low carbon rail now being carried out at two points on the Atlanta division of the N. C. & St. L., also to make a study of the wear on each side of the joint gap between fishing surfaces and the head of the rail on the joints, with the intention of endeavoring to find the relative effect on the fit of the joints when laid suspended, supported or neutral.

The following is a summary of the data submitted with this report and for comparison there has also been added to the table batter measurements made on 75 tangent rails on the test Mile 106 of the Chattanooga division, N. C. & St. L.

Reading Railroad Measurements, Rail Laid in April, 1924, Measured on August 11, 1927

Number and Description of Joints	Batter on Receiving End	Joint Gap	Rate of Batter per Mo.	No. of joints Chipped	No. of joints Frozen	Approx. Annual Gross Tonnage
50-Continuous, Head Free, 24" long, 130-lb. R. E. Rail	.0100 x	15.34 +— 64	.00024	4	17	8,000,000 to 10,000,000
50-100% Head Free Angle Bars, 24" long, 130-lb. R. E. Rail	.0131 xx	9.6 +— 64	.00032	3	21	8,000,000 to 10,000,000
50-100% Head Contact Angle Bars, 24" long, 130-lb. R. E. Rail	.0192 xxx	8.62 +— 64	.00047	6	32	8,000,000 to 10,000,000

x—.0011 = Batter on leaving end.
xx—.0017 = Batter on leaving end.
xxx—.0019 = Batter on leaving end.
4
+— = A.R.E.A. Recommended Expan. Allow. for 90° Rail Temp.
64

N. C. & St. L. Railway Measurements, Rail Laid in June, 1923, Measured on September 15, 1927

Number and Description of Joints	Total Batter	Rate of Batter per Month	Approx. Annual Gross Tonnage
67-Head Contact Angle Bar Joints, 24" long, 110-lb. R. E. Rail, Single Track Tangent	.0260	.00051	12,000,000

The batter measurements include only that for the receiving end of the rails on the Reading tracks, while on the N. C. & St. L. it includes both, the latter being single track.

The following is quoted from the letter transmitting this report:

> "It appears to me that these measurements indicate that our previous belief that the 'Head-Free' Continuous joint is the best type of joint for our use, is well founded, because according to our figures there is less batter to the rails where the 'Head-Free' Continuous bars are used than with the other types."

At the chairman's request, Mr. Wrenshall removed a pair of "Head-Free" continuous joint bars from the southward track at a point where the rail was laid in 1922. Mr. Wrenshall's observations to the wear of the plates are abstracted as follows:

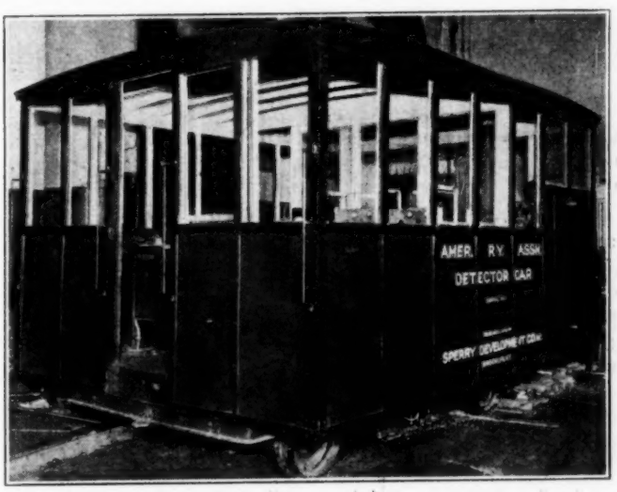
Outside Plate: Receiving end worn smooth on top and on side of fillet. Leaving end worn for full length on top but little wear on side of fillet except for 3 in. near end of rail. Part of plate fitting top of base of rail worn slightly for full length but hardest on leaving end for first 7 in. from end of rail. Part of plate fitting under base of rail worn only under receiving end.

Inside Plate: Receiving end worn smooth on top and on side of fillet for full length but much harder on first 6 in. from end of rail. Leaving end worn uniformly on top and on side of fillet except no wear on first 1½ in. at end of plate. Part of plate fitting top of base of rail worn for full length of receiving end and on leaving end only for first 3½ in. from end of plate. Part of plate fitting under base of rail worn for full length of leaving end and on receiving end only for first four inches from end of plate."

Equipment for Detection of Transverse Fissures*

THE DETECTION of defects of internal origin in rail heads, particularly of the transverse fissure type, is a problem on which attention and study have been focused for the last fifteen years. Failures of this type were noted where the development appeared at the surface underneath the rail head and could be traced by the streak of rust at the hairline separation. Mirrors were then constructed on standards or brackets and could be moved along by hand with the reflection from beneath the rail head indicating the location of breaks. The method proved slow, laborious and had the further objection that detection of failures was impossible until the development had reached the contour of the rail section.

The next important development was the experimental work of the Bureau of Standards, commencing in 1915 with a magnetic testing device for this same general purpose. The apparatus was essentially a magnetizing solenoid surrounding the rail, search coils to detect flux leakage at irregularities in the material, and a galvanometer in circuit as the indicator. Subsequently the work initiated at the Bureau was enlarged upon by two railroads



The Sperry Tranverse Fissure Detector Car

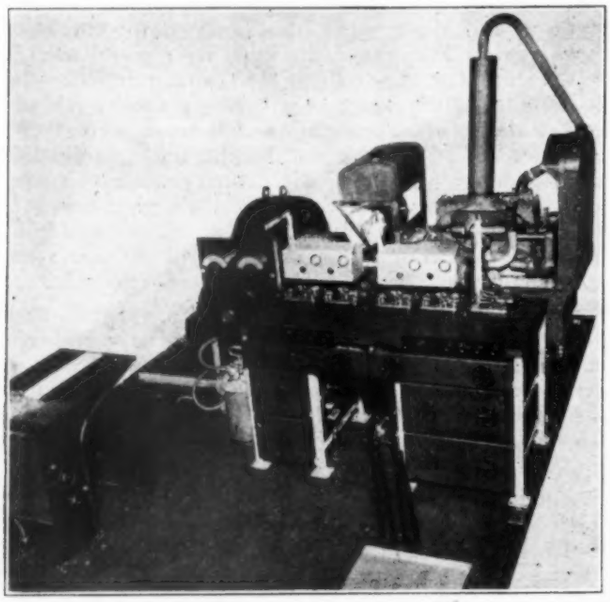
and one steel company, but after exhaustive tests over a period of several years the method was discontinued as lacking practical value for application in service. The apparatus, while highly sensitive and accurate, produced results from which it was impossible to differentiate between the effect of slipping of drivers, gagging and cold bending of rails, accidental spike maul blows on the rail, cold rolling

*Presented as a supplemental report of the Committee on Rail.

effects of wheels, segregation, laminations and head breaks such as transverse fissures.

Present Experiments Involve New Principle

It was more than two years ago when E. A. Sperry, of the Sperry Development Company, Brooklyn, N. Y., conceived the idea of utilizing the air-gap resistance effect of dissociated particles or areas in the interior of rail heads to disclose their identity. His method was to force a high current at low voltage through the rail, and by continuously moving a set of conductors along the rail length energize the entire rail. The resistance effect of discontinuities in the head could be detected by a pair of brushes which would pick up this minute potential difference and transmit it to radio amplifying tubes to increase



View Showing All Elements of the Sperry Detector as Mounted in the Car

the impulse sufficiently that the needle in a galvanometer would detect, or else to actuate pens through relays for a permanent paper record.

Mr. Sperry outlined his plans to the Rail committee of the American Railway Engineering Association, two years ago. His proposal and several suggested methods of various types and principles were investigated, and after due consideration the recommendation was made to the Board of Direction for an initial appropriation of $2,000 for a cooperative experimental study in the laboratory of the Sperry Development Company, which was granted.

Laboratory equipment was designed and assembled early in 1927, and failed rails of various weights, sections, rollings and manufacture were furnished by several railroads. The apparatus proved successful from the start, and internal breaks which were only 2 per cent of the head area were discovered, while the early expectations were that 15 per cent would likely be the minimum transverse separation within the head that could be detected.

Furthermore, it was demonstrated that unless discontinuities existed in the rail head there was not the slightest deviation of the needle of the galvanometer or movement of the recording pens, indicating that the rails were structurally sound and normal. To check this broad assertion several rail heads were fractured in short lengths under the steam hammer and were entirely free from any indications of internal breaks or separations, and therefore checked the records from the experiments with the testing apparatus. The operation became so proficient that the size and location of each internal transverse fracture in the cross-section of the rail head could be foretold very accurately. Holes were drilled vertically into the top of the rail head and were so accurately centered that the point of the drill would meet the opposing faces of the fissure within the head.

Failure of Magnetic Method Explained

In the course of the experimental work, light of more than usual interest was thrown on the reason why the magnetic method failed to differentiate between the various physical characteristics of the material itself and transverse fissures themselves. This was because the transverse fissures could only operate the galvanometer through their functioning as air gaps, which were supposed to interrupt the flow of magnetic lines.

The laws and mathematics governing the magnetic flux in air gaps have become perfectly understood and the reason why the air gap presented by a true transverse fissure gave no useful effect as an air gap, is the fact that the element of length is practically non-existing. This has been proved through the experiment referred to below by the fact that with the Sperry method the location of the fissure can be made with very high degree of precision, so much so that a drill point may actually enter the fissure.

The reason for drilling was to introduce a fluid of the halogen group, which is possessed of extremely small molecules, expecting this fluid to freely penetrate and discolor the two entire opposing faces of the fissure. The interesting fact was developed that after repeated applications of this fluid even under some pressure, the rail was broken at this point and not the slightest penetration could be observed, proving that the actual gap between the surfaces is sub-molecular in dimension and therefore submicroscopic, because the little spheres representing the smaller molecules of even a halogen, not only could not force their way into the crevice, but could not enter it to the slightest extent, leaving the surface bright. This thorough test on over 50 rails demonstrated that the laboratory equipment had proven the soundness of the basic principles involved, and indicated its promising possibilities.

An agreement was subsequently reached between the Sperry Development Company and the American Railway Association in August, 1927, for the construction of a track car to be used under service conditions for the detection and marking of internal failure in rail heads. Pioneering work was required for a new device of this character and although the details and the assembly were pushed as speedily as possible, it was not until the latter part of December that the car was ready for tests other than those in the laboratory.

Description of the Sperry Detector

In general, the Sperry detector car consists of a standard track maintenance trailer car upon which is built an enclosure containing the power plant, radio apparatus and recording mechanism. A motor

car is required for towing purposes as the detector car is not equipped for self-propulsion. The operating speed is expected to be approximately ten miles per hour. In arrangement, the power plant is located on the forward end of the platform, and includes a 25 hp. gas engine, with necessary starter and auxiliaries, direct connected to a 4000-ampere, 2-volt generator operating at 900 r.p.m.

One of the illustrations shows the contact brushes of the detector on the top surface of the rail, between which flows the energizing current. Each contact assembly consists of eight individual copper brushes pressed against the rail head by springs. These brushes are mounted in a rigid frame which is raised and lowered by a lever in the car. There are two sets of eight brushes in contact with each line of rails. Small potential brushes are shown mounted between the conductors and form the mechanism for picking up the difference in potential from the resistance effect of the air gap at the internal break in the rail head. This micro-voltage is carried to a set of four radio tubes which step it up two to three hundred thousand times.

Near the center of the same illustration, the paint spraying device can be seen. A relay controls the release of a spray of paint against the side of the rail whenever a defect is found at any point in the length of the rail.

Within the car there is a table containing the necessary batteries for the tubes, above which there is a suspended aluminum case containing the amplifiers. On top of the table there are 10 relays which are required for various purposes. Within the car there is also a recording table on top of which travels a friction-driven moving strip of paper. Directly in contact with the paper are seven pens which are actuated by the relays in circuit with the tubes.

Special Mechanism Records Position and Relative Size of Fissures

Fissures located in one line of rails are indicated on the paper by three pens, and a similar set of pens for the opposite line of rails. The center pen records location of joints. The relays are so adjusted that a short transverse line is drawn by one pen if the internal break is of small area; two pens operate if the break is of intermediate size, and all three pens operate if of large area. The fissure pens are automatically thrown out of circuit when the pen for location of joints operates.

The three lines on the left of the record indicate defects in the left hand rails; the middle lines indicate the joints, and the three right hand lines indicate defects in the right hand line of rails. The short transverse lines thus permanently record the location of internal breaks and their size or area. A numbering machine also conveniently identifies each rail on the record, while the paint spray notifies the trackmen of the existence and location of defective rails.

An auxiliary feature of the car is the rotary scratch brushes set ahead of the front contact brushes to remove rust or foreign material from the running surface of the rail to insure good contact for the electrical brushes. A buzzer or horn is also placed in the car, operated by a relay for the purpose of notifying the operator and as a further check on the proper functioning of the apparatus.

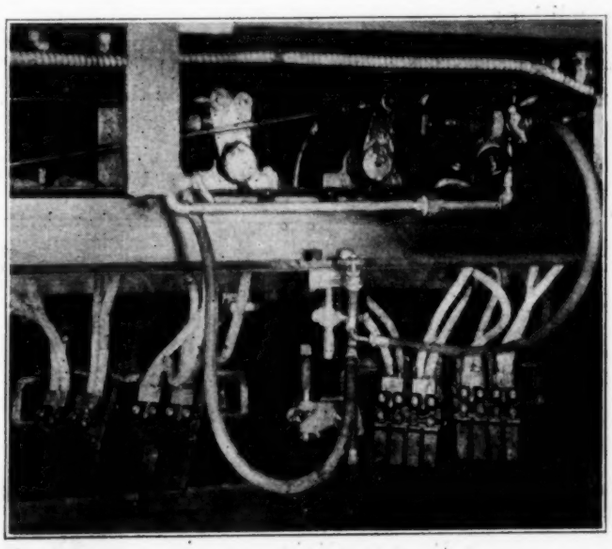
Final acceptance of the detector car was made contingent upon a successful and satisfactory road service test under the supervision of the Rail committee. A test track was selected on the New York Central in the yard at Beacon, N. Y., 58 miles north of New York, and was set aside entirely for this purpose. The 650 ft. of track was laid with portions of failed rails removed from service, from 8 to 22 ft. long, and of various rollings from 1913 to 1925 of the 6-in. 105-lb. Dudley section. Each rail length had developed a transverse fissure in service.

The rails were all first carefully tested by hand, using a portable coil and galvanometer. Subsequently the detector car was towed over this track for preliminary trials of the functioning of the apparatus, and it was found necessary to make several minor changes in the equipment for more satisfactory operation. The car is now being tried on the main line high speed track for extended tests to develop the serviceability of the device and to determine the most satisfactory operating conditions. When these trials are completed the car will be given further tests on other roads throughout the country.

Discussion

[Chairman Earl Stimson (B. & O.) presented the report and introduced the subcommittee chairman, Hunter McDonald (N. C. & St. L.), who outlined the report on the cause and prevention of rail battering which was presented as information. Mr. McDonald also referred to the possibility of the development of a wrench which will successfully measure the force which a man exerts on the nut in tightening the bolt.

W. C. Barnes (Engr. of Tests, Rail Committee) presented for information the report on rail failure



View Showing Main Current Brushes, Searching Brush Between Them and Paint Gun Nozzle

statistics which was so received, following which, C. B. Bronson (N. Y. C.) submitted the progress report of the Committee on Mill Practice. Chairman Stimson then outlined the two outstanding features of the activities of the committee during the year; the formation of a joint committee with the rail manufacturers' technical committee for the purpose of collaborating in the study of the causes of rail failures; and the development of the transverse fissure detector car. He also called attention to an exhibit presented by the committee which was put on display, consisting of a short section of rail con-

taining the first transverse fissure detected by the detector car in actual operation.

Mr. Bronson then presented the supplemental report of the committee on the Sperry transverse fissure detector car and his remarks were received with applause. President Brumley asked for comments from the members and called upon a number present.]

J. V. Neubert (N. Y. C.): I have great faith in the detector car. Many are in doubt as to what it will do. The car does indicate, but not to the perfection in actual track service as it did in the Sperry plant. Rome was not built in a day and I do not believe the car will be developed in a day, but I think if we have confidence this machine will do what it is expected to do.

R. J. McComb (Q. & C. Co.): I have not had an opportunity of seeing the detector in operation for the past few months, but personally I am absolutely satisfied that with a little development work and ironing out the imperfections which are sure to occur in any new device, the detector will be a great success.

C. W. Baldridge (A. T. & S. F.): I have not had anything to do with, nor have I seen the Sperry detector car. It is a very interesting development and certainly one to be much commended. In this connection, however, I think it is only fair to give credit to a present member of the Rail committee, Mr. Chapman, for pioneer work on this line. He started the investigations of a rail transverse fissure detector, using a magnetic scheme, but unfortunately, it was affected by any irregularity in the top of the rail, to such an extent that it gave many false conditions.

Dr. J. S. Unger (Carnegie Steel Company): Our people have tried for many years to develop an instrument of some sort that would show the presence of transverse fissures in a rail. We spent considerable time and money in trying to further develop the magnetic method. The manufacturer is interested to the same extent that the railroad is, in the future development of the Sperry transverse fissure detector.

A. N. Talbot (U. of Ill.): The question has been raised as to whether an instrument would be able to distinguish between transverse fissure and other defects or other lack of homogeneity in the rail.

Mr. Bronson: The basic principle of this device is the discontinuity within the railhead. As long as there is a separation of the particles within the head, they may not be entirely transverse, they may be partly longitudinal and partly transverse, this apparatus will absolutely pick up the defect.

G. H. Tinker (N. C. & St. L.): Is it the thought of the committee that the use of this machine will throw any light upon the cause of the formation of these fissures originally? Will the machine be further developed so that it may be available for use in the mills before the rails are put into track for the detection of incipient fissures?

I judge from what has been said that there would be absolutely no difference in the indication of the detector from a transverse fissure or a pipe or artificial fissure in the rail.

Mr. Bronson: The machine will not detect a pipe on account of the fact that the pipe is longitudinal and the fissure is transverse. It is based entirely on transverse dissociation within the head. Possibility of the utilization of this principle for determining the cause of fissures in rails is under very careful consideration. Later will come the development of the use of the device for new material.

[Following the discussion from the floor, Chairman Stimson expressed appreciation for the co-operation of the New York Central, and after a number of complimentary remarks by President Brumley, the committee was excused with the thanks of the association.]

Report of the Committee on Grade Crossings

Hadley Baldwin (C.C.C.& St. L.)
Chairman
J. Astrue (S.P.)
O. C. Badger (Perm.Waterproof. Co.)
F. D. Batcheller (B.& O.)
H. D. Blake (Wis.Highway Com.)
B. Blum (N.P.)
J. G. Brennan (N.Y.C.)
R. E. Chamberlain (B.& O.)
W. E. Colladay (I.C.)
R. D. Copeland (Ann Arbor)
L. B. Curtiss (N.P.)
J. F. Deimling (M.C.)
A. F. Dorley (M.P.)
G. N. Edmondson (N.Y.C.)
R. A. Feldes (I.H.B.)
H. W. Fenno (N.Y.C.)
C. E. Herth (B.& O.)
M. V. Holmes (A.T.& S.F.)
W. O. Houston (M.C.)

Hadley Baldwin

F. J. Stimson (Penna.)
Vice-Chairman
R. L. Huntley (U.P.ret.)
Maro Johnson (I.C.)
F. G. Jonah (St.L-S.F.)
R. B. Kittredge (U.of Iowa)
A. E. Korsell (C.R.I.& P.)
A. C. Mackenzie (C.P.R.)
G. P. Palmer (B.& O.C.T.)
J. W. Purdy (B.& O.)
L. J. Riegler (Penna.)
F. Ringer (M-K-T)
L. P. Rossiter (L.V.)
E. H. Roth (N.&W.)
T. E. Rust (W.C.F.& N.)
H. M. Shepard (Erie)
M. D. Thompson (I.C.)
W. J. Towne (C. & N.W.)
A. H. Utter (C.B.& Q.)

THE COMMITTEE presented reports on the following subjects:

(1) Revision of Manual (Appendix A);

(2) Continue the study of methods for apportioning the cost of highway improvements adjacent to railway rights-of-way (Appendix B).

(3) Investigate and report on the comparative merits of various types of grade crossing protection, collaborating with the Committee on Signals and Interlocking (Appendix C).

(4) Continue the study of the excessive number of highway grade crossings of railways, with meth-

ods for their removal (Appendix D).

(5) Continue the study and report on the economic aspects of grade crossing protection in lieu of grade separation (Appendix E).

(6) Investigate and report on the use of center columns for highway grade separation.

(7) Study and report on various types and locations of approach and warning signs for grade crossings, also the practices in the several states and federal requirements, with a view to securing uniformity of practice and standards (Appendix C).

(8) Continue the study and report on (a) laws and regulations affecting the apportionment of federal aid; (b) the proper form and character of the division of costs of separation of grades as between the railway, state, county, municipal or other corporation (Appendix F).

The committee recommended that Appendix A and the conclusions in Appendix C be adopted and published in the Manual; that the report in Appendix D be accepted and that the recommendations be referred to the Board of Direction; that the recommendation in Appendix F be approved and referred to the Board of Direction for transmission to the American Railway Association; and that the report in Appendix B be received as information. Progress alone was reported on subjects 5 and 6.

Appendix A—Revision of the Manual

Following instructions given at the 1927 convention, the committee gave consideration to the design of the highway crossing sign, and a plan was prepared and mailed to the membership. The replies received numbered 176. They brought out comment on the following features of the sign:

Auxiliary Sign Showing Number of Tracks at Crossing—Fifty-seven members approved the crossbuck sign with auxiliary sign as designed by the committee; 50 members approved the use of the auxiliary sign, but suggested changes in its details or those of the crossbuck sign; 43 members opposed the use of the auxiliary sign; 26 members were non-committal as to the use of the auxiliary sign.

Those opposed to the auxiliary sign regard it as unnecessary, liable to distract the attention of the motorist, and to lead to legal difficulties.

Crossbuck Sign

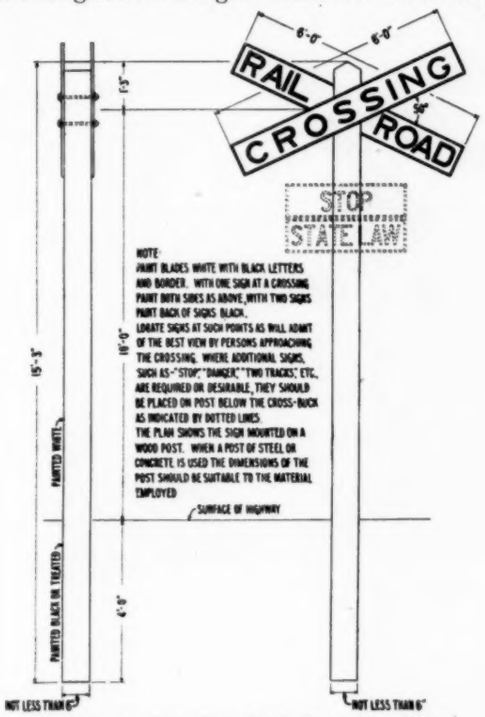
The most frequent suggestion received was that the post be striped. The Committee on Grade Crossing Protection of the A. R. A. has objected to the striping of the post for the reason that it may be mistaken by a motorist for a crossing gate in the open position. The convention of the A.R.E.A. in 1927 voted to omit the striping from the post.

Several objected to painting a black border around the edge of the blades. All signs now shown in the Manual have black borders, and the border on the highway crossing sign is in conformity therewith.

Several members think the sign is too high. Two members think it not high enough. Some have evidently regarded the dimensions of 11 ft. 3 in. as showing the height of the top of the post as applying to the center of the sign.

Two or three suggest that the angle of the blades be 60 deg. instead of 50 deg. because the former is easier for the carpenter to lay out. Five members, including three signal engineers, favor the use of the sign shown on page 396, Volume 27 of the Proceedings, with 4-ft. blades at an angle of 90 deg., as adopted by the Signal Section and this Association for use with flashing light or wigwag signals.

Suggestions were also made that a post 8 in. by 8 in. may be larger than necessary, that the portion of the post in the ground should be creosoted, and that the height of the sign should be measured from


RAIL
CROSSING
ROAD
STOP
STATE LAW
NOTE
PAINT BLADES WHITE WITH BLACK LETTERS AND BORDER. WITH ONE SIGN AT A CROSSING PAINT BOTH SIDES AS ABOVE, WITH TWO SIGNS PAINT BACK OF SIGNS BLACK.
LOCATE SIGNS AT SUCH POINTS AS WILL ADMIT OF THE BEST VIEW BY PERSONS APPROACHING THE CROSSING. WHERE ADDITIONAL SIGNS, SUCH AS "STOP," "DANGER," "TWO TRACKS," ETC., ARE REQUIRED OR DESIRABLE, THEY SHOULD BE PLACED ON POST BELOW THE CROSS-BUCK AS INDICATED BY DOTTED LINES.
THE PLAN SHOWS THE SIGN MOUNTED ON A WOOD POST. WHEN A POST OF STEEL OR CONCRETE IS USED THE DIMENSIONS OF THE POST SHOULD BE SUITABLE TO THE MATERIAL EMPLOYED
SURFACE OF HIGHWAY
PAINTED WHITE
PAINTED BLACK OR TREATED
NOT LESS THAN 6"
NOT LESS THAN 6"

Recommended Standard Crossing Sign

the surface of the highway rather than the ground line adjacent to the post. Several correspondents also called attention to state requirements in conflict with this sign.

After carefully considering all suggestions received, the committee recommended the adoption of the sign approved at the 1927 convention with minor modifications above mentioned and omitting specific requirement for an auxiliary sign showing number of tracks at crossing.

Appendix B—Methods for Apportioning the Cost of Highway Improvements

The report of the committee was confined to improvements in cities and towns. The work was started by sending a questionnaire to the chief tax officers of 14 roads. Answers were received from the Great Northern, the Illinois Central, the New York New Haven & Hartford, the Northern Pacific, the Southern Pacific, the Southern, and the Union Pacific. The replies in general were quite complete and are summarized in the composite answers as follows:

(1) There is general agreement that assessments for street or highway improvements should be in proportion to benefits received. There is also a general agreement that the benefits to non-operating railway land from improvements are the same as to similarly located private property. There is also agreement that the benefits to be derived from improvements adjacent to station grounds is greater than those adjacent to right-of-way for roadway only.

(2) The front-foot rule is cited as an unfair basis, as it generally results in railways standing one-half

the cost, irrespective of the areas involved or benefits received. Another unfair method is to require the railway companies to bear the entire expense across the right-of-way when the balance of the improvement is paid from general tax funds.

(3) In some sections of the country it is common practice to assess railways for road improvements

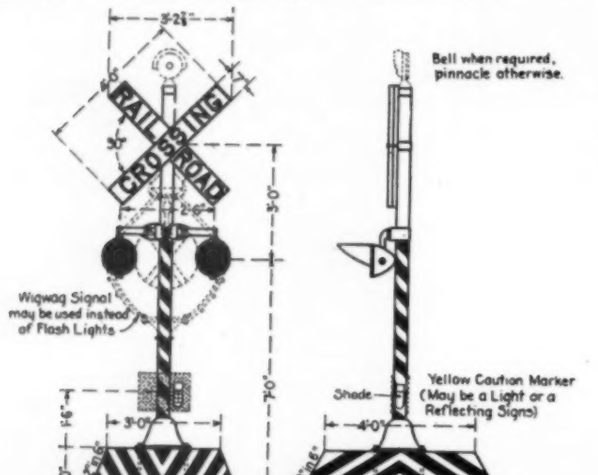

Bell when required, pinnacle otherwise.
RAIL ROAD CROSSING
Wigwag Signal may be used instead of Flash Lights
Shade
Yellow Caution Marker (May be a Light or a Reflecting Signs)
Top of Roadway

Fig. 1 Recommended Flash-Light or Wig-Wag Signal

not abutting the right-of-way. This has been done through the so-called zone method. There does not seem to be much objection to this method if carried out consistently.

(4) The general tendency is to pay for improvements by direct assessments against the property affected. In a number of cases street and alley intersections are paid from the general tax funds and in a few cases the entire cost is paid from general tax or bond issues.

(5) Most replies indicate that repaving cost is paid for in the same manner as the original paving, but some exceptions are noted where the charter provides for the city to maintain pavements.

(6) The average amount of assessments for highway improvements for those roads reporting has been approximately $25 per year per mile of road operated. The number of assessments has varied from one to three per hundred miles of road operated.

Appendix C—Merits of Various Types of Grade Crossing Protection

An examination of the annual reports sent to the Interstate Commerce Commission shows that there were 1,457 more grade crossings on December 31, 1926, than on December 31, 1925, in spite of the fact that 1,254 crossings were actually eliminated during 1926.

Four types of crossing protection were reported to the commission. These are gates, watchmen, signals and fixed signs.

Below is a statement showing the relative number of each type on December 31, 1925, as compared with December 31, 1926:

Kind of Protection	*1925*	*1926*	*Increase*	*Decrease*
Gates	6,386	6,170	.....	216
Watchmen	7,935	7,765	.....	170
Fixed Signs	202,348	202,620	272	.....
Signals	12,964	13,992	1,028	.....
Sub-Total	229,633	230,547	914	.....
Otherwise Unprotected	4,068	4,611	543	.....
	233,701	235,158	1,457	.....

It will be noted from this statement that the number of crossings protected by signals is gaining, while the use of gates and watchmen is decreasing. As reported last year, we believe that the signal type of protection is the best when protection is needed and that this is being recognized by the railways and governmental authorities.

In order to show what progress has been made in reducing accidents at highway grade crossings the following tables are given for the years 1925 and 1926:

GRADE CROSSING ACCIDENTS ACCORDING TO TYPE OF PROTECTION

	Number of Accidents		*Persons Killed*		*Persons Injured*	
Kind of Protection	*1925*	*1926*	*1925*	*1926*	*1925*	*1926*
Gates	210	227	115	100	143	175
Watchmen	568	603	164	195	734	718
Signals	777	884	392	478	867	999
Fixed Signs	3897	4148	1535	1718	4811	5099
	5452	5862	2206	2491	6555	6991

NUMBER OF DEATHS AND INJURIES ACCORDING TO TYPE OF CONVEYANCE

	Killed		*Injured*	
Kind of Protection	*1925*	*1926*	*1925*	*1926*
Motor propelled	1797	2080	5938	6371
Animal drawn	62	49	155	126
Pedestrians	299	300	273	261
Miscellaneous	48	62	189	233
	2206	2491	6555	6991

The accompanying tables show that there were 285 more persons killed and 436 more persons injured in 1926 than in 1925, but an examination of the number of motor vehicles registered shows that on December 31, 1925, there were 19,954,357, while on December 31, 1926, there were 22,046,957 registered, or an increase of 2,092,600 motor vehicles.

This shows that a material improvement has been made in reducing accidents, but there are still too many accidents at crossings, due very largely to carelessness on the part of drivers.

Where grade crossing protection is necessary there should be a uniform type of signal which would be recognized by the public in any part of the country. Figure 1 shows the type of flashlight or wigwag signal which we recommend. Where these are used they should replace the standard crossbuck crossing

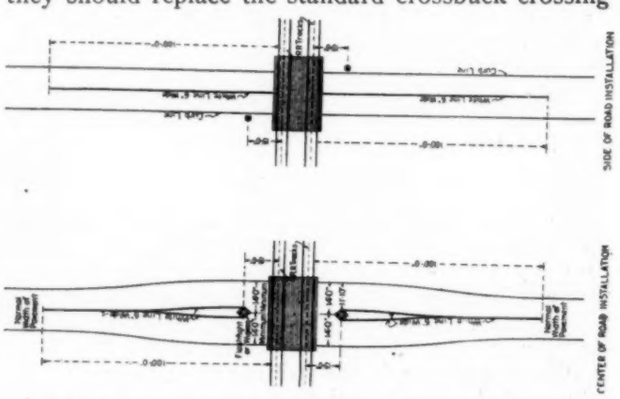


Fig. 2 Recommended Location of Crossing Signal

sign. Where practicable they should be placed in the center of the highway. It was reported that 37 states now use the warning signs recommended and adopted by the American Association of State Highway Officials, although some of them do not use the yellow background. Eight states require railways to bear the cost of installation of warning signs and five states require the railways to maintain them.

It was recommended that advance warning signs be placed at important crossings, as it is desirable that motorists receive advance information that they are approaching a railway crossing in time to bring their

cars under control. Where required by law or regulation, the stop sign should also be used.

Conclusion

The committee recommended that Fig. 1, showing a flashlight or wigwag signal, and Fig. 2, showing the location of the signal, be adopted as recommended practice and that they be placed in the Manual.

It also recommended that the advance warning signs and stop signs, Fig. 3, and the location of these signs, Fig. 4, which have already been adopted by the American Association of Highway Officials, be approved as recommended practice.

Appendix D—Excessive Number of Highway Grade Crossings

Statistics show that, notwithstanding the large expenditures for grade separation each year, the number of grade crossings is actually increasing and that accidents are not confined to crossings with bad approaches or poor visibility. There are many crossings which can be closed or consolidated and a serious effort should be made in this direction. Public interest and safety should impel public authorities to make a reduction in the number of grade crossings one of their most important activities. Not only are municipal, county, and state authorities involved in this problem, but it should enlist the active interest of the federal government by reason of the interstate character of much of the highway traffic.

The excessive number of grade crossings will continue until some method is provided by which the several arms of the government participate in solving the problem. The difficulties have been discussed from time to time, but until there is genuine activity along feasible lines, not much will be accomplished. The extraordinary expense attending grade separation has retarded elimination; in fact, the cost is so great as to discourage both the railways and the public authorities in such undertakings.

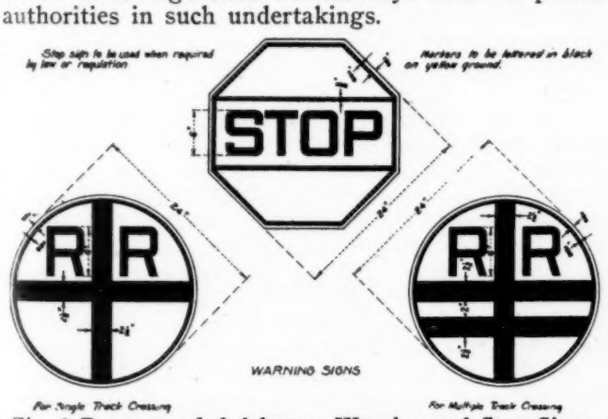

Stop sign to be used when required by law or regulation
Markers to be lettered in black on yellow ground.
STOP
R R
R R
WARNING SIGNS
For Single Track Crossing
For Multiple Track Crossing

Fig. 3 Recommended Advance Warning and Stop Signs

To solve the problem adequately, some method should be adopted that will eliminate a large number of existing crossings at negligible expense as compared with grade separation. Such a plan would comprise the prohibition of new grade crossings or their restriction to unavoidable situations. Along with this it should provide for the vacation or closing of existing grade crossings not manifestly necessary for the convenience and welfare of the community, or the diversion or relocation of highways to avoid grade crossings. The cost of diversion usually is less than for grade separation, and it will serve the purpose of elimination as well as grade separation. Grade separation should be limited to situations where none of the other methods can be used and where the traffic is such as to require it.

Restriction of New Grade Crossings

Some effort has been made in recent years to restrict the establishment of new crossings but the number is still being increased each year. Statistics of the Interstate Commerce Commission covering the last three years show the number of grade crossings at the ends of each year to be as follows:

1924	232,710
1925	233,633
1926	235,158

To ascertain the present attitude of public authorities on this question, a questionnaire was sent to

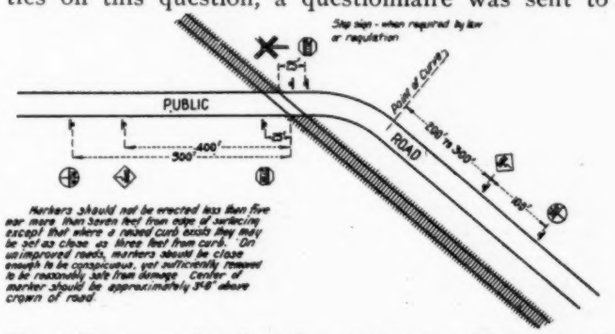

Stop sign - when required by law or regulation
PUBLIC
ROAD
Point of Curve
200' to 300'
400'
300'
Markers should not be erected less than five nor more than seven feet from edge of surfacing except that where a raised curb exists they may be set as close as three feet from curb. On unimproved roads, markers should be close enough to be conspicuous, yet sufficiently removed to be reasonably safe from damage. Center of marker should be approximately 3'6" above crown of road.

Fig. 4 Recommended Location of Advance Warning and Stop Signs

each of the states and to Canada.

The replies indicate that in 26 states a tribunal has been erected whose consent must be obtained before a new grade crossing can be established. Usually the authority is vested in a public service or public utility commission, but in some cases in railway or highway commissions or the common pleas court of the county. Approval generally is given only after a public hearing and in some cases the railway may appeal to another commission or to the courts. In two of the states there seems to be no formality required. Two states prohibit the creation of new grade crossings and a large number prohibit new grade crossings on state roads. In eight states the power to create grade crossings seems to lie with the board of county commissioners, although in some cases their action is subject to appeal to the courts. Nearly all the replies indicate a decided and strong tendency to restrict and in some cases to prohibit additional grade crossings.

Elimination of Existing Grade Crossings

In view of the ease with which grade crossings have heretofore been established, there are, no doubt, many that can be vacated and closed without any substitute and without unreasonable inconvenience to the public or damage to local landowners. Where roads are not abandoned grade crossings upon them may in some cases be closed without unreasonable inconvenience. This would seem to be particularly true in towns and cities having parallel streets a few hundred feet apart.

The cost of grade separation has constantly increased so as to be practically prohibitive in many cases. It would seem, therefore, that large railway systems can well afford to assign an engineer to the special duty of studying the grade crossing situation,

with a view of finding situations where the above methods can be put into practice through negotiations with public authorities.

The same study will disclose situations where existing grade crossings may be eliminated by diversion or relocation of the highway and in some cases by the relocation of the railway tracks. A grade separation project should only be undertaken after a thorough study has been made as to what other crossings may be closed or the roads diverted to a separated crossing, and care should be taken to insure that the project is properly located to handle all general traffic adequately.

Where a highway crosses a railway twice within a few miles, relocation of the highway generally furnishes the best and most economical solution. Where a second highway enters or crosses one to be diverted or relocated the situation becomes complicated, unless the highway can be closed. If investigation demonstrates that it is impractical to close the road, grade separation of one crossing is more economical than for two crossings.

An effort should be made to locate new highways and relocate or divert existing highways, through structures already existing on the railway.

No grade separation project should be undertaken until a thorough investigation has been made to fit the project into the general scheme of highway transportation. A study should also be made to determine the possibility of diverting other roads to the crossing to be separated, and no grade separation projects should be undertaken without complete investigation to determine whether or not such construction will interfere with future improvements of the railway.

Recommendations

It is recommended that the American Railway Association be requested to adopt means and use its influence to get before the public and public authorities the desirability of enacting such laws as will assist in restricting the creation of new grade crossings, permit closing and vacation of existing grade crossings, relocation and diversion of highways to avoid or eliminate grade crossings and finally for authorities more discretion to enter into agreements with the railways. An effort should be made to enlist grade separation. The statutes should give public the aid of the Federal government and to secure a more equitable apportionment of cost from state, county and municipal authorities.

It is recommended that the railways, particularly the larger systems, definitely assign engineers to study the grade crossing situation on their lines.

It is further recommended that the railways then take the initiative in negotiating with town boards, county, and state officials, with a view to closing or combining those crossings where the survey indicates that the conditions are favorable.

Appendix F—(a) Laws and Regulations Affecting the Apportionment of Federal Aid; (b) The Division of Costs

After giving a statement of the provisions of the Federal Highway Act, as amended, and of regulations pertaining thereto, the committee made the following comments:

The committee understands the present practice, under the rulings of the Bureau of Public Roads, is that federal aid may be allotted to the construction of railway grade crossing separations to the extent of 50 per cent of the cost thereof, except that the federal authority has declined to reimburse the state for more than the amount actually paid by the state.

Under the provision of the federal aid act a definite allotment of funds is made to each state, which is the maximum of federal aid which it may receive from the amount appropriated. It follows, therefore, that if federal aid is not used for paying any part of a railway grade separation, the state has an accordingly greater amount left for use on other road improvements.

It is understood that there is no provision of the federal aid act which railway companies can use to compel the states, through legal proceedings, to apportion part of the federal aid allotment to a particular grade separation project.

Following these comments there was given a list of the provisions of the various states governing the division of costs of highway grade crossing eliminations.

Division of Costs of Separation of Railway Grade Crossings

The recommendations of the committee under this head were as follows:

(1) Authority to order grade crossing eliminations, separations, or proper protection at grade crossings should be vested in the state commission or other state body having jurisdiction over railways, which should also determine and enforce the proper division of cost between the railways and the public.

(2) The Federal Highway Act should be amended to provide that every elimination of a grade crossing of a railway with a federal aid highway should be included in a federal aid project and federal aid should be applied to such crossing elimination to the extent of 50 per cent of the cost thereof.

(3) The cost of a grade crossing elimination in excess of the federal aid allotment thereto should be apportioned between the state and/or subdivision thereof and the railway company on the basis of the conditions at such crossing, and of the benefits arising from such elimination.

These recommendations were followed by a tabulated summary of replies to a questionnaire with reference to the division of the cost of elimination of grade crossings of federal aid highways constructed from the date of the federal valuation, to Dec. 31, 1926, which was presented as Exhibit A.

Discussion

[Hadley Baldwin (C. C. C. & St. L.), chairman of the committee, presented the report.]

Mr. Baldwin: Procedure in the field of this committee's work will always be cramped by conflicting influences until the public has awakened to a clearer realization of what constitutes the true economy of the situation. There must be some way to have it made clear to the people of this country that in the last analysis it is not the part of wisdom to consider it solely in behalf of the general public interest to raise all or most of the great cost of grade crossing relief and protection by the rule of having it concealed in the cost of freight and passenger transportation.

[The revision of the Manual was presented by Maro Johnson (I. C.), chairman of the subcommittee.]

Mr. Johnson: After carefully considering all sug-

gestions received, the committee recommends the adoption of the sign approved at the convention of 1927 with minor modifications and omitting specific requirement for an auxiliary sign showing number of tracks at crossing as shown.

Within the last day or two the suggestion has been made that inasmuch as the Association of State Highway Officials and also the Committee of Engineering Counsel have adopted yellow as the background of all caution signs, including the railroad caution approach and stop signs, the crossbuck sign should possibly also be painted yellow. The committee is not willing to recommend this change without some investigation. Presumably such a suggestion would apply equally to the frame and support of the automatic crossing signals.

I move that the highway crossing sign shown be adopted as standard practice and further consideration be given to the color of background in the committee's assignment for next year.

H. C. Crowell (Penna.): The method of weighing or equating the answers from the various members is not given by the committee. I think it is most unfortunate that the tentative standard plan issued indicated 10 tracks. Ten tracks is not a typical grade crossing in this country. We are interested in those crossings, particularly, that have one track or two tracks, possibly some that have three tracks. Many fatal accidents on the grade crossings of this country are due to the fact that the motorist starts out after the train has passed on the near track and does not realize there is another track hidden from view, and that a train may be coming on that track. If we can save only one-half dozen lives in the course of a year, I will say if we can save only one life by putting the sign "Two Tracks" on that crossing, that it is well worth the expenditure and I think this argument of the committee is not a good one.

Into a yard crossing of 10 or 12 tracks, I grant you it makes little difference whether a change of sign is made as soon as the additional yard track is laid across, but it does make all the difference in the world when you change a single track grade crossing to a double track.

The third argument regarding uncertainty as to whether the sign is designed to state the number of active tracks, such as main tracks and switch leads, or whether it is to indicate the total number of tracks. This may be interpreted differently by different railroads, adding to the confusion. Can we not place on our standard plan a clear statement as to what is wanted in that respect? I think it should be the total number of tracks.

Let us realize that the motorist does not care about the ownership of the tracks. He is going over a grade crossing. If the tracks of that grade crossing are so widely spaced that there is room for several automobiles between the tracks, then I submit that it becomes two separate grade crossings and should be properly signaled.

If, on the other hand, there is not sufficient distance between the tracks to allow several automobiles to stand after having passed one, and waiting for traffic on the other, then it becomes a single grade crossing, and it seems to me that railroads paralleling each other could very easily take care of that situation, which should be outlined on the plan.

Mr. Johnson: I have not the votes here, but there are two schools of thought on this question and both sides are decided that their view is correct. The committee felt that the 43 men who voted against the proposition carried more weight, and certainly represented more mileage than the 107 men who voted to place the sign on the post.

C. W. Baldridge (A. T. & S. F.): As I remember the letter which was sent out asking an immediate vote, it was from R. H. Aishton (A. R. A.), in regard to signs, and they were considering this very feature of passing a law compelling the roads to show certain additional information.

I contend that a board on a crossing sign showing the number of tracks to be crossed gives definite information to the driver which he is entitled to.

Mr. Chairman, *I offer an amendment to the motion before the house, to read as follows,* "that the design for crossing sign be amended by the addition of a board to be placed immediately below the state law board on which shall be shown the number of tracks to be crossed, and that the plan so amended be adopted for inclusion in the Manual."

L. J. Riegler (Penna.): Membership of this association is composed of private individuals and not of appointed representatives from the various railways. It seems to me, therefore, the mileage of any individual membership should be limited at least to six feet.

The approach sign in Virginia has two horizontal stripes for railroads regardless of the number of tracks. The A. R. A. sign is one stripe. If we put this sign up voluntarily you can see what is going to happen. In one place it will mean two tracks. The Supreme Court decision said that if a man entered on a railroad track, or tracks (it is immaterial), he knew that he was in a dangerous place and that if he did not get off that railroad before the train came he was liable to be killed.

I have a tremendous sympathy for you poor Western men, single-track railroads, who come East and get onto one of our great double-track trunk lines. It seems to me our duty ceases first when we indicate by an approach sign that the driver is approaching a railroad; second, showing where the railroad is, and third if the crossing is so bad that he cannot see the trains, to give him an indication that there is a train approaching and if he does not know, if he cannot see, there is more than one track there, day or night, it is either because his eyesight is so bad that he should not be allowed to drive or that his headlights do not conform with the law.

Chairman Baldwin: The committee was requested to prepare a design with the board indicating the number of tracks to be crossed, but did not feel that in view of the diverse responses and the small percentage of response from members of the association that it would be justified in recommending it for adoption.

W. E. Hawley (D. M. & N.): I feel that it would be a mistake to put such a recommendation definitely in the report because with those states and those railroads which do not choose to follow that, in case of an accident, it will be used against them in court as a failure to follow a recommendation of this association, which undoubtedly will be explained to the court, and make it appear bad against the road.

W. L. Roller (H. V.): It may be that the information as to the number of tracks will be disregarded by the major number of motorists. However, many instances are on record where accidents have occurred due to the fact that this information was not given, and I think the railroad is peculiarily re-

sponsible that fails to give the information to the motorist, whether it is regarded or not.

Mr. Crowell: It is just such an accident as that that I had in mind. The small cost involved in putting up this little additional information is little compared with the value of the human life.

V. R. Walling (C. & W. I.): I wonder if Mr. Baldridge would consider changing the amendment which applies to the sign for single track to read, "Single Track Only," and for crossings of more than one track indicate "More Than One Track." That will get away from the point of definitely naming the number of tracks.

Mr. Baldridge: I would accept that change in the amendment.

G. H. Tinker (N. C. & St. L.): I think that sign would be more effective if the first one were omitted entirely. If there is to be any additional board at all indicating the number of tracks, there should be a board saying simply more than one track.

[Mr. Tinker's suggestion was accepted as a further change in the amendment. *The amendment was voted upon and was lost.*]

Mr. Crowell: In view of the fact that the committee itself was about equally divided and that only a small portion of our membership are here this morning to vote on this subject and so few voted on the letter ballot, I should like to make an amendment to *the motion before the house that the whole matter be referred to the committee for further study.*

W. M. Post (Penna.): I think it might be well for the committee to state whether there would be any useful purpose served by having it referred back to the committee. I anticipate that if another ballot is sent out they will get about the same response from just about the same percentage of the membership.

[*The amendment of Mr. Crowell was voted upon and carried.* Subject No. 2 was presented by B. Blum (N. P.), subcommittee chairman. F. D. Batchellor (B. & O.) presented the report on subjects No. 3 and 7, and after some discussion it was referred back to the committee. The study of the excessive number of highway grade crossings of railways, with methods for their removal, was presented by Mr. Riegler, subcommittee chairman.]

Mr. Riegler: To solve the problem adequately, some method must be found that will eliminate a large number of existing grade crossings at negligible expense compared to grade separation. Public authorities can be relied upon to bring up questions of important highways for grade separation, but for highways of lesser importance, and equally dangerous from the railroad standpoint, it is the opinion of the committee that the railroad should take the initiative. The report is presented for the purpose of having it accepted and the recommendations contained therein referred to the Board of Direction.

S. T. Wagner (Reading): About eight years ago I attended a conference called by the National Association of Railroad and Utilities Commissioners, at which a representative of the State Highway Department of Wisconsin upbraided the railroads for their lack of interest in the removal of grade crossings, which he said could be accomplished for $15,000 a piece. When I had a chance I called attention to the fact that that year I had especially investigated the cost of removal of grade crossings in Pennsylvania and had found that they averaged about $75,000. A representative of the New York Central stated that I should figure at least $120,000 or $125,000 for an average. The chairman of the Pennsylvania State Commission referred to an individual project of the state where three grade crossings had been eliminated at a total cost of something over $3,000,000.

On our system we made plans for the removal of three grade crossings of an alley in a municipality in Eastern Pennsylvania. The estimated cost was $4,500,000. When the municipality found they would probably have to pay half of the cost, they were not so interested and the project was dropped. Within the last six months, I have noticed figures given in the RAILWAY AGE showing the cost of removal of grade crossings in the state of New York under the New York state law. The gross costs of those crossings are given as I remember the figures, in the first block running up to $150,000 per crossing and in the second block running over $175,000 a crossing.

R. H. Ford (C. R. I. & P.): The Rock Island has adopted a policy that they will not permit any additional grade crossings to cross its line under any circumstances without bringing the matter before the commerce commissions in the respective states in order that it may be in a position to point out to the commission that if it create that crossing, the responsibility is going to be with the commission. In one state in the last year I think a little over two-thirds of all the crossings that have been proposed have been refused by the commissions because they did not care to take that responsibility. Another thing the Rock Island is doing in that connection is that whenever a new grade crossing is up for elimination, the engineers study the situation themselves and insist that one or more, usually more, grade crossings shall be closed as a part of the negotiations.

F. C. Shepherd (B. & M.): We have about a hundred crossings affected by the New York state law. We sugested that some 30 crossings should either be closed because they were not important, or should be closed by short side line roads. Three crossings have been closed by side line roads, costing a little over $3,500. We pay one-quarter and they pay the other part.

[F. Ringer (M-K-T) presented the report on regulations affecting the apportionment of Federal aid and the division of costs of separation of grades, following which it was *moved that the recommendations be approved and referred to the Board of Direction for transmission to the American Railway Association.*]

Mr. Ford: Before the motion is put I should like to refer the committee to that portion of Section 2 which reads: "and Federal aid should be applied to such crossing elimination to the extent of 50 per cent of the cost thereof."

[After a discussion participated in by Mr. Ford, Mr. Ringer, H. H. Kirkbride (S. P.) and C. C. Westfall (I. C.), Mr. Ford withdrew an amendment which he suggested to the effect that the last line of Section 2 be changed to read as follows: "and Federal aid should be applied to such crossing elimination to an equitable per cent of the cost thereof." *The motion of Mr. Ringer for approval of the recommendations of the committee was then voted upon and carried.* The committee was then excused with the thanks of the association.]

Report of Special Committee on Convention Procedure

THE special committee appointed by President Brumley from the Board of Direction to consider and report on a plan for such changes in the practices and procedure of the A. R. E. A. as seemed best adapted to enhance the value of the work done by the various committees and by the association itself, presented a report in which an exhaustive review was made of the earlier history of the association and the development in procedure to the present time. The report, in which the committee pays tribute to the founders who established the board principles for the organization and procedure of work of the association, is abstracted below:

The great advances in development and the changes in economic life have brought demands for broader and more comprehensive application of science in railway transportation, the results of which are to require a better understanding, as well as a more scientific application of the agencies through which it can be obtained, this, in turn, finds expression in greater obligations on the standing and special committees, by which, under the plan of work of the American Railway Engineering Association, research, study and investigations of railway engineering problems are made.

Sectional Meetings

It has been necessary to add other standing and special committees from time to time until there are now nearly double the original number. This has led to a belief among some of the members that better results would be accomplished if sectional meetings were held, thereby permitting members to attend meetings at which reports are being made upon the subjects in which they are more directly interested, and in this manner, the entire problem would be correspondingly advanced as several sectional meetings could be in progress at the same time during the convention.

Suggestions have been made to group related subjects which would be reported and discussed at these sectional meetings. It has been held that by this means, more discussion of the subjects by those especially qualified or interested therein would be afforded, thereby securing better and more complete results than is possible under existing practice. In support of this, comparisons are made with the procedure of the American Society of Civil Engineers, and other national organizations. The American Railway Engineering Association differs fundamentally from these and similar organizations in that all the members are interested in the broad subject of railroads and very few have their interest limited to one phase of the subject.

The present-day practice of railway engineering consists of the selection and application of the best methods in both the general and specialized subjects; therefore, chief engineers, engineers of maintenance, division engineers and other railway officers, and those who have the ambition to become such, should be and are interested in both the general and specialized subjects, and no procedure may be considered good that will prevent the hearing of all subjects, whether general or special, by all those members who desire to hear them. Any plan which would confine the members' attendance to a portion only of the reports, must inevitably reduce both the interest and the value of the work in the association. Replies to the questionnaires from past officers, chairmen of standing committees and the membership generally are overwhelmingly against the proposal, substantially for the reasons stated.

Three-day vs. Four-day Convention Period

With the increase in membership and importance of the association, has come a corresponding increase in its activities and reports. This has been met by closer scheduling of the convention hours in order that the entire program may be presented during the three-day session. It is felt by some of the members that the point of saturation has been reached and that this cannot be relieved without either curbing the reports or reducing the effective work of the convention, and that they would meet this situation by increasing the present three-day convention period to four days.

It is believed that before the four-day session becomes necessary, consideration should be given to the possibilties of lengthening the present schedule of the convention or by other expedients, resorting if necessary to one or more night sessions as occasion demands, as was the practice in former years.

Decreasing Number of Subjects Reported Upon

Suggestions have also been made in favor of decreasing the number of subjects assigned to standing committees, on the theory that it will enable a greater amount of time to be devoted to the consideration of committee reports and other convention activities. If the objectives of the American Railway Engineering Association are to be properly attained, all matters relating therto should at all times be kept in the foreground and constructively advanced by research, analysis and creative discussion.

As the membership increases, it would seem desirable to increase, if necessary, rather than decrease, the number of subjects assigned to them. As long as there are subjects of this character requiring investigation, and as long as men are ready and willing to devote their time to the research work necessary for its accomplishment, it would be unwise to alter the present practice. The replies to the questionnaire are overwhelmingly against any change, the standing committee reporting in the ratio of five to one against a reduction of subjects.

It is held by some that better results will be secured if several of the principal standing committees were now combined so that the inter-related or overlapping subjects may be thus handled by the combined committee. We do not share this belief. Rather, we conclude that the more recent practice of the board of direction of requiring collaboration between independent committees on those features which are thus related, gives assurance of better results.

It is our belief that experienced independent committees so organized as to cover the well defined fields of railway operation, working on broad lines and with proper contacts on inter-related subjects, will maintain a better interest and secure more satisfactory results than through organizations rendered more or less inarticulate through mass action.

Minority Reports

Suggestions have also been made with respect to majority and minority reports; largely, however, with the view of encouraging discussion, which will be referred to later. It is our belief that minority reports are not in general desirable and should not be presented unless all means have been taken to adjust the differences in the committee. As a general rule, final reports should not be presented until they have the unqualified en-

dorsement of a large majority of the committee members.

Volume of Reports

With the growth of the American Railway Engineering Association has come a corresponding increase in its publications. It is believed on the part of some of the members that the reports have now become too voluminous and should be reduced, either by a careful paring down of irrelevant matter or by some other method that would insure a reduction in the amount of published material.

There can be no question but that it is possible to boil down many of the reports more than is now being done, but the fact cannot be overlooked that the chairmen of the committees and sub-committees are volunteeer workers with widely different ideas regarding the extent to which brevity is desired, and that as a practical matter, it is not best to insist that they condense their reports to the minimum. The easiest way to reduce the volume of reports is to discourage work on the part of the members of a voluntary organization. There are notable cases where this has been done. In one instance which has come to our notice, this has been so admirably accomplished, that it is now an open question among the members as to whether the organization should not be abolished.

Early Publication of Committee Reports

There is a widespread belief among the members that committee reports are received too late to permit proper study before the annual convention. The question is not new. It is a problem over which the board of direction and the secretary have been deeply concerned for years. If it can be permanently corrected, many of the conditions for which remedies have been suggested would, in our opinion, satisfactorily adjust themselves.

The questionnaire shows a very large majority in favor of some action of this character.

Grouping of Reports

It has also been recommended that in the convention program the reports of the standing committees be grouped in such a way that related subjects shall follow in logical sequence, thereby causing the least disturbance of interest at the convention in the presentation of subjects which are closely related. It is claimed that by this method members who cannot attend all sessions of the convention can better arrange their plans for taking part in the presentation and discussion of subjects in which they are particularly interested.

This subject has also in the past been given careful consideration by the board of direction and the secretary. The difficulties attending it are due in no small degree to the lateness with which committee reports are received.

The questionnaire has indicated a very large majority in favor of this plan.

Letter Ballot on Matter for Manual

It has been urged by some that action of the convention on the approval of material for the manual should be so limited that final action shall be the result of letter ballot sent to all members of the association after the close of the convention. It is suggested that by this means, a better and more deliberate consideration will be obtained than is possible under present methods, because the majority of the association are not present at annual conventions, and the convention vote may not be representative of the full membership.

An analysis of the daily registrations at annual conventions of the American Railway Engineering Association indicates that the daily convention attendance is thoroughly representative of the membership. The percentage of corporate members voting by letter ballot on questions submitted by the American Society of Civil Engineers varies somewhat with the importance of the subject and the efforts made to induce voting, yet the highest number voting on any question in recent years was 45 per cent. As a rule it runs from 18 per cent to 32 per cent.

The average attendance at annual conventions of the American Railway Engineering Association is about 40 per cent of the membership, from which it would appear that there is a better and more representative attendance of the members in a position to pass on the subjects before the convention, as well as a more reasonable assurance of a larger vote than would be secured if the letter-ballot were employed.

It does not appear that there is any justification for a change in the present practice, and the results of the reports and questionnaire fully support this conclusion.

The Manual of Recommended Practice

Representations have been made to the effect that the Manual is not sufficiently interesting, attractive or comprehensive; that it should be prepared in a different manner; and that the material forming its contents should be revised and edited by a staff of paid experts for revision before publication. Considering the purposes for which this Manual is prepared and used, we believe it would be unwise as well as impracticable to assign to any supervising corps of persons, expert or otherwise, the task of altering or changing the work of the commitee organizations upon whom rests the responsibility for its preparation and revision, as aforesaid.

More Discussion on Convention Floor

More discussion on the floor of the convention is favored by a majority of more than 60 per cent of the replies to questionnaires. One of the principal reasons given for the lack of discussion is the short time between the publication of committee reports and the annual convention. As previously stated, this has been largely eliminated this year and should afford an excellent means of determining whether the greater opportunity for studying committee reports will bring about more discussion on the floor of the convention.

Our experience has been that there is very thorough discussion of the subjects reported upon in the committee meetings before the conclusions reached in the reports are determined upon. The committees are now generally drawn from among the best material available in the association and their reports constitute the results of careful study of the subjects by groups of the most expert men who can be found on the respective subjects. The majority of these men are now thoroughly trained in committee-work. They have the excellent work and example of past committees to draw upon, and there is little wonder that they produce reports which permit of very little discussion. Usually the more thorough the study of these reports, the less will be the tendency to discussion of them.

General

The subjects which have been referred to constitute the principal topics upon which questions have arisen. In addition, to these, numerous suggestions on various matters have been received, many of them excellent and constructive in character, and while important in themselves, they are largely more or less related to the subjects already covered by this inquiry.

These suggestions along with the other information bearing upon this subject of convention procedure consist of three large volumes. They have been catalogued and indexed and will be filed with the secretary for future reference by the board of direction.

RECOMMENDATIONS

1. That rules be adopted that will insure that bulletins containing the reports of standing and special committees are available for the membership on or before February 1 of each year.

2. Except in special cases where it is to the interest of the Association that the board determine otherwise, reports received by the Secretary after the date determined as necessary to comply with the above rule (1) shall be received as progress reports.

3. Subject to the adoption of rules 1 and 2, and after a suitable interval has elapsed to observe their effect on convention program, the board should again study the matter to determine what additional means, if any, are desirable, with particular reference to the congestion of program and the promotion of constructive discussion.

4. That in arranging the annual program, reports of standing and special committees shall, as far as practicable, be so grouped that related subjects shall be in logical sequence.

Robert H. Ford, Chairman; G. D. Brooke, W. D. Faucette, E. H. Fritch, C. E. Johnston, G. J. Ray, Louis Yager.

Closing Business

After the dismissal of the last of the committees whose reports are presented above, the president called for a report from R. H. Ford (C. R. I. & P.), chairman of the Committee on Co-operative Relations with Universities, and following a brief statement from Mr. Ford relative to the present status of the work of that committee the convention proceeded to closing business, which included the installation of officers. Following some brief remarks by the new president, W. D. Faucette, he announced the names of the chairmen of the committees of the board of direction, which are as follows:

Finance Committee—A. Montzheimer, chairman.
Publications Committee—Louis Yager, chairman.
Library Committee—J. E. Armstrong, chairman.
Outline of work for standing committees for the next year—R. H. Ford, chairman; D. J. Brumley, vice-chairman.
Personnel of Committees—J. V. Neubert, chairman; G. D. Brooke, vice-chairman.
Special Committee on Manual—J. L. Campbell, chairman.
Committee on Membership—G. D. Brooke, chairman.

He also announced the appointment of W. D. Simpson (S. A. L.), R. T. Scholes (C. B. & Q.) and R. C. Bardwell (C. & O.) as the committee on arrangements for the next convention, with Mr. Simpson as chairman. The convention was then adjourned.

A. R. E. A. Registration

FIFTY-TWO members and 37 guests registered at the convention Thursday, bringing the total registration up to 968 members and 348 guests, or a combined total of 1,316. This compares with a total registration last year of 925 members and 346 guests, or a total of 1,271, and a registration in 1926 of 831 members and 199 guests, or a combined total of 1,030. This year's figures established a new record in the history of the association, being the first time in which the number of members registered has exceeded 950 and the total registration has exceeded 1,300. Thirty-seven per cent of the entire membership attended the meeting this year.

Alphabetical List of Members

Ackerman, C. E., Jr., office engr., A. C. & Y., Akron, O.
Atwill, A. Lee, asst. engr., C. & W. I., Chicago.
Barry, H. B., prin. asst. engr., St. L.-S. F., St. Louis, Mo.
Buck, J. A., asst. engr., Wabash, Springfield, Ill.
Cole, Charles F., Jr., instrumentman, M. P., McGehee, Ark.
Crawford, D. T., supt., G. T. W., Battle Creek, Mich.
Dansey, J. W., A. T. & S. F., Chicago.
Davidson, W. A., asst. engr., M. P., Jefferson City, Mo.
Downs, L. A., pres., I. C., Chicago.
Fatherson, T. W., supt., C. G. W., Clarion, Ia.
Filippi, Hugo, pres., William Grace Co., Chicago.
Foley, John, asst. to purch. agt. Penna., Philadelphia, Pa.
Gillam, W. R., roadmaster, I. C., Clinton, Ill.
Goodwin, W. R., engr. of timber preservg., M. St. P. & S. S. M., Minneapolis, Minn.
Haggander, G. A., brdg. engr., C. B. & Q., Chicago.
Hanley, W. S., chf. engr., St. L. S., Tyler, Tex.
Harding, C. D., supvr. of br. and bldgs., G. T., Battle Creek, Mich.
Harrell, J. G., instrumentman, M. P., Monroe, La.
Harrison, M. J. J., genl. scale insp., Penna., Chicago.
Hatt, W. K., div. engr., A. T. & S. F., Chanute, Kan.
Hillary, W. R., sls. engr., National Lock Washer Co., Newark, N. J.
Hopton, J. M., instrumentman, M. P., St. Louis, Mo.
Hubley, R. S., engr. wood presrv., G. N., St. Paul, Minn.
Jackson, C. T., dist. engr., C. M. St. P. & P., Chicago.
Lane, E. G., asst. chf. engr. maint., B. & O., Baltimore, Md.
Mann, B. H., cons. sig. engr., M. P., St. Louis, Mo.
May, A. D., asst. engr. M. P., Little Rock, Ark.
McCormick, R. L., prof. civil engrg., Rose Polytechnic Institute, Terre Haute, Ind.
Montgomery, J. F., div. engr., St. L. S., Mt. Pleasant, Tex.
Paquette, C. A., pres., M. E. White Co., Chicago.
Pariseau, J. N., chf. draftsmn., N. P., St. Paul, Minn.
Purdy, J. W., dist. br. supt., B. & O., Akron, O.
Ryan, S. F., supvr., Wabash, Mexico, Mo.
Schlinkert, W. E., supvr. of scls., I. C., Centralia, Ill.
Schmitt, A. P., instrumentman, M. P., Monroe, La.
Scott, H. E., contr. engr., Industrial Track Construction Co., St. Louis, Mo.
Shieber, J. H., asst. engr., M. P., St. Louis, Mo.
Shurtleff, A. K., asst. secy., A. R. E. A., Chicago.
Skov, L. W., office engr., C. B. & Q., Chicago.
Spielmann, J. A., asst. to genl. supt., B. & O., Pittsburgh, Pa.
Steinberger, M. F., spcl. engr., B. & O., Baltimore, Md.
Upson, A. T., National Lumber Mfrs.' Assn., New York City.
Wenzell, A. P., spcl. engr., M. C., Chicago.
Westfall, C. C., engr. br., I. C., Chicago.
White, R. C., asst. genl. mgr., M. P., St. Louis, Mo.

Guests

Amory, E. E., Jr., Du-Wel Steel Products Co., Chicago.
Ayles, St. L.-S. F., Hugo, Okla.
Baldwin, Springfield, Aurora, Ill.
Blair, F. I., asst. engr., I. C., Chicago.
Blanchard, W. H., asst. engr., C. M. St. P. & P., Milwaukee, Wis.
Brice, N. R., draftsman, Wabash, St. Louis, Mo.
Brown, D. M., Lewis Institute, Chicago.
Bruns, H. N., sig. maintr., Wabash, North Liberty, Ind.
Bryant, W. B., I. C., Chicago.
Burkhart, R. G., asst. engr., M. P., St. Louis, Mo.
Burt, C. S., supt. t. & t., I. C., Memphis, Tenn.
Campbell, L. M., engr. computer, C. C. C. & St. L., Cincinnati, O.
Crossman, A., A. R. A., Chicago.
Dean, Aaron, Union Switch & Signal Co., New York City.
Dean, T. O., supt. of scales, T. & P., Dallas, Tex.
Downard, T. E., supvr. br. & bldgs., I. C., Hattiesburg, Miss.
Ericson, C. G., mech. engr., Toronto, Ont.
Erskine, James, asst. engr., C. R. I. & P., Chicago.
Ganier, A. F., asst. engr., N. C. & St. L., Nashville, Tenn.

Hand, Wm. E., eng. computer, C. C. C. & St. L., Cincinnati, O.
Holland, C., instrumentman, C. M. St. P. & P., Milwaukee, Wis.
Howard, W. J., pres., Kelly-Atkinson Construction Co., Chicago.
Kinghorn, A. A., Toronto, Ont.
Kistler, L. W., supt. trtg. plants, St. L.-S. F., St. Louis, Mo.
Larkin, M., I. C., Chicago.
Lipetz, A. I., cons. engr., American Locomotive Co., Schenectady, N. Y.
Martin, G. E., supvr. water serv., I. C., Hattiesburg, Miss.
Notley, H. E., Geo. P. Nichols & Bro., Chicago.
Redfern, C. R., St. Catherine, Ont.
Rosemire, L., supvr. trk., C. & O., Sciotoville, O.
Rybolt, L. F., asst. div. engr., B. & O., Indianapolis, Ind.
Seaholm, J. M., secy. to asst. ch. engr., C. R. I. & P., Chicago.
Schlinkert, F. H., supt. of scales, M. P., St. Louis, Mo.
Schnebelen, J. J., asst. engr., M. P., St. Louis, Mo.
Sizemore, C. S., ch. tie. insp., I. C., Memphis, Tenn.
Starr, A. L., Chicago.
Stockmann, C., Chicago.
Tesh, Murray, asst. engr., Wabash, Montpelier, O.
Timmons, M. E., Portland Cement Assn., Chicago.
Wachter, R. E., asst. engr., M. P., St. Louis, Mo.
Waddell, K. M., cons. engr., Toledo, O.
Winter, Carroll, asst. on engr. corps, B. & O., Cincinnati, O.
York, E. L., masonry insp., I. C., Chicago.

Little Rollo and His Pop*

Chapter IV. In which Rollo attends the annual banquet and acquires a great deal of physical and mental food

"GEE, Pop, you look great," piped Rollo, as his father appeared in his dinner jacket, "but remember what Mom said. No soup on the boiled shirt this year for you."

"There'll be no soup at all for you, young man," replied Pop, "if you don't mend your ways."

As they entered the banquet hall, Pop said: "I want you to be good tonight, young man, and not make a scene as you did this afternoon."

"Why, what did I do this afternoon?" asked Rollo, surprised.

"Nothing at all, except that you shouted out, so that it could be heard everywhere: 'Where's Mr. Brumley's running pants?' What was the idea of that, may I ask?"

"Gee whiz, Pop," answered Rollo, "that wasn't my fault. As we went in, that bell boy outside the door was yelling: 'Railway track meet now going on inside.' Gosh, I expected to see Mr. Knowles pole-vaulting, Mr. Faucette throwing the hammer and Mr. Ford putting the shot. I thought I was going to see Mr. Brooke throwing the javelin and Mr. Fritch running the half-mile. Shucks, I was so disappointed."

Now comes the wonderful part. Incredible as it may seem, Rollo was silent for the space of at least half an hour. There was food before him, and food and a growing boy have always had a strong affinity one for the other since time immemorial. He did break forth once, however, when the Fair of the Iron Horse procession, done in ice, came in, but his mouth was full of "yard layout, with plans attached," so all that came forth was a much muffled "Gee."

Even after the meal, he sat around in a state of repletion until the flower throwing by the singing maidens began. In the course of chasing after the flowers, our young hero upset seven waiters, four chief engineers, one roadmaster and an engineering editor, but the latter doesn't really count because he was sitting on a defective chair. Pop retrieved the young nuisance at last and he sat docilely enough during the course of Mr. Downs' address.

"What makes Mr. Downs' voice so loud and clear?" he asked.

"He's been training it recently, my boy. There are a lot of slow foursomes down in Florida and yelling 'Fore' a sufficient number of times is excellent vocal training."

After Mr. Downs' speech, Rollo went into a somewhat protracted trance, but he awoke as the cup was being presented to Mr. Brumley. "Hey, Pop," he yelled at the top of his voice, "does he have to win it three times to keep it?"

"No, my lad," replied his father, "and that isn't the only cup that graces the Brumley mantel. Mr. Brumley collects cups with his little mashie-niblick as well."

"What will Mr. Faucette's wife say, Pop, when he brings home the clock?"

"She'll probably say: 'Well, dear, possibly there's some sense in your traipsing out to Chicago after all.'"

As they were leaving the hall, Pop said: "I don't think you listened to the Canadian gentleman's speech."

"Oh you mean Mr. Brumley's cousin?"

"No, no, that's the man I mean, but he's no relative, what did he talk about."

"Well," said Rollo, "he talked about an hour."

"My boy, you're getting sleepy. It's time you were turning in."

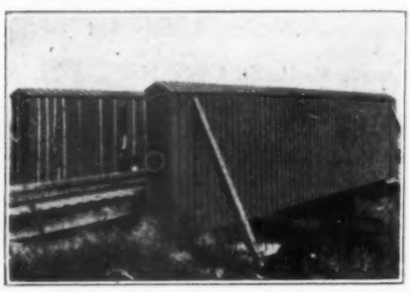
"All right, Pop, good night."

"Good night, my boy."

"Say, Pop, I had a darned good time here at the convention."

"So," said Pop, "did I."

*Editor's Note.—With this installment, the series is concluded, since poor old Pop was so worn out by the week's catechism that he left for home last night. However, they may be back next year, you never can tell.



Railway Bridges on the Illinois Central Thirty Years Ago

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Note Inspector at Work on Left